NSW NATIONAL PARKS & WILDLIFE SERVICE

River Red Gum Ecological Thinning Trial

Monitoring report 2022 Appendices

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Cover photo: Partially flooded river red gum forest. Emma Gorrod.

This report should be cited as: Gorrod E, Chu N, Inman V 2022, *River red gum ecological thinning trial: Monitoring report 2022 Appendices*, NSW National Parks and Wildlife Service, Hurstville.

Published by:

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ISBN 978-1-922900-15-9
EHG 2022/0547
October 2022

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Contents

1. Photo points

Photos from the floristic plots of a selection of sites for each survey year.

Site 1 – Site Quality 2

	Control 1-2-C	Moderate 1-1-A	Heavy 1-3-B
2015			
2017			
2018			
2019			
2020			
2021	Unable to be surveyed in 2021 due to flood waters		

Site 2 – Site Quality 1

	Control 2-2-A	Moderate 2-3-C	Heavy 2-1-C
2015			
2017			
2018			
2019			
2020			
2021	Unable to be surveyed in 2021 due to flood waters	Unable to be surveyed in 2021 due to flood waters	Unable to be surveyed in 2021 due to flood waters

Site 7 – Site Quality 2

	Control 7-1-C	Moderate 7-2-B	Heavy 7-3-B
2015			
2017			
2018			
2019			
2020			
2021			

Site 10 – Site Quality 2

	Control 10-1-B	Moderate 10-2-A	Heavy 10-3-B
2015			
2017			
2018			
2019			
2020			
2021			

Site 22 – Site Quality 1

	Control 22-2-B	Moderate 22-1-A	Heavy 22-3-C
2015			
2017			
2018			
2019			
2020			
2021			

2. Description of model summaries

2.1 Explanatory variables

The labels for explanatory variables in each model included the following fixed effects:

- thinning = the proportion of trees removed by thinning, a value between 0 and 1
- initSD.log = the natural logarithm of initial tree density (trees per hectare)
- yrs.elapsed = the number of decimal years that had elapsed between the commencement of thinning on that site and the survey date
- site.quality = a factor for Site Quality 1 and Site Quality 2.

The labels for explanatory variables in each model included the following random effects (Figure 1):

- site = a factor for the 22 sites
- siteplot = a factor for the 66 x 9-hectare plots
- subplot = a factor for the subsampled plot within each 9-hectare plot
- year.factor = a factor for the repeat survey of subplots in up to 6 survey years (2015–16, 2017–18, 2018–19, 2019–20, 2020–21, and/or 2021–22). Note that year.factor is used as a fixed effect in some models, and that one additional survey year was available for bats.

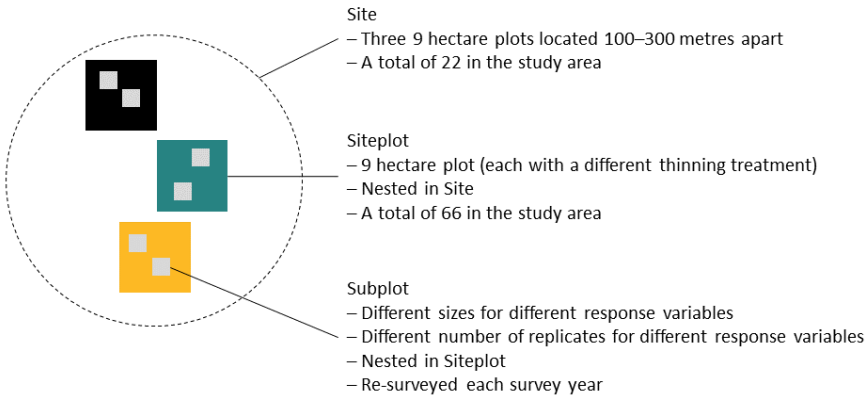

Figure 1 Schematic of spatial relationship between site, 9-hectare plot and subplot random effects

Random effects were specified so that each entity was assigned a unique factor level, which allowed for nested effects to be modelled.

2.2 Candidate models

For most response variables several candidate models were considered. In the model summaries presented in Sections 0 to 16 below these are referred to by their model names, which are further described in Table 1. Where models deviate from these standard candidate models, further details are provided in the model summaries.

Table 1 Descriptions of model names

Model name	Model specification	Effect being tested
4_way	y ~ poly(cbind(thinning, initSD.log, yrs.elapsed), 2) * site.quality + thinning * initSD.log * yrs.elapsed * site.quality + random effects	Allows for the effect of thinning intensity to depend on initial stem density and for this relationship to change over time and differ among the site qualities.
4_3way	y ~ poly(cbind(thinning, initSD.log, yrs.elapsed), 2) * site.quality + thinning:initSD.log:yrs.elapsed + random effects	Removed the 4-way interaction between thinning, initial stem density, years since thinning and Site Quality. Allows for effect of (i) thinning to change over time and differ among Site Qualities; (ii) an underlying effect of initial stem density to vary over time that differs among Site Qualities; (iii) thinning to depend on initial stem densities and differ among Site Qualities; (iv) thinning to depend on initial stem densities and vary over time.
3_3way	y ~ poly(cbind(thinning, initSD.log, yrs.elapsed), 2) * site.quality + random effects	Removed the 4-way interaction between thinning, initial stem density, years since thinning and site quality. Allows for effect of (i) thinning to change over time and differ among Site Qualities; (ii) an underlying effect of initial stem density to vary over time that differs among Site Qualities; (iii) thinning to depend on initial stem densities and differ among Site Qualities.
3_way_noyrs.elapsed but year.factor as a fixed effect	y ~ poly(cbind(thinning, initSD.log), 2) * site.quality * year.factor + random effects	Allows for the effect of thinning intensity to depend on initial tree density and differ among site qualities. Changes in these relationships over time are related only to survey year (a factor with six levels), not time since thinning (a continuous measure).

2.3 Descriptions of model terms

In the model summaries presented in Sections 0 to 16 below the model terms are abbreviated according to the notations described in Table 2.

Table 2 Summary of model terms

Model term	Model name	Model term label in model summary
Site quality	All models	site.qualitySQ2
Initial stem density	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0

Model term	Model name	Model term label in model summary
Initial stem density^2	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0
Years elapsed	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1
Years elapsed^2	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2
Thinning intensity	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0
Thinning intensity^2	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0
Thinning intensity * initial stem density	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0
Thinning intensity * years elapsed	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1
Initial stem density * years elapsed	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1
Thinning intensity * years elapsed * initial stem density	4_way and 4_3way	thinning:initSD.log:yrs.elapsed
	3_3way	not included
Initial stem density * site quality	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2
Initial stem density^2 * site quality		poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2
Years elapsed * site quality and Years elapsed^2 * site quality	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2 poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2
Initial stem density * years elapsed * site quality	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2
Thinning intensity * site quality	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2
Thinning intensity^2 * site quality		poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2
Thinning intensity * initial stem density * site quality	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2
Thinning intensity * years elapsed * site quality	All models	poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2
Thinning intensity * initial stem density * years elapsed * site quality	4_way	site.qualitySQ2:thinning:initSD.log:yrs.elapsed
	4_3way and 3_3way	not included

3. Model summaries: Tree survival

3.1 Tree mortality

Table 3 Model fitting summary: tree mortality

Response	Proportion of 50 trees per 9-hectare plot that were dead Modelled as the ratio of dead to live trees
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Binomial
Outliers removed	None
Reported model formula	3_3way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 6 survey years)
Other transformations compared	None
Other models attempted	Gaussian • 4_way: Boundary (singular) fit • 4_way (with 1 outlier removed): Boundary (singular) fit • 3_3way: Model convergence problem; non-positive-definite Hessian matrix Binomial • 4_way: Model convergence problem; non-positive-definite Hessian matrix • 4_way (with 1 outlier removed): Model convergence problem; non-positive-definite Hessian matrix
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (9% of 999)

Model summary 1 Tree mortality

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	–2.16	0.13	–16.52	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	5.54	1.70	3.25	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	0.31	1.40	0.22	0.82
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–3.41	2.45	–1.39	0.16
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–29.37	37.20	–0.79	0.43
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–0.07	2.38	–0.03	0.98

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	0.30	0.93	0.32	0.75
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–3.10	18.29	–0.17	0.87
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	5.03	17.85	0.28	0.78
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	1.35	0.78	1.73	0.08
site.qualitySQ2	–0.17	0.19	–0.90	0.37
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–3.33	2.21	–1.50	0.13
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–2.70	2.39	–1.13	0.26
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	2.55	3.29	0.78	0.44
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	45.80	52.74	0.87	0.39
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	3.45	2.94	1.17	0.24
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	0.97	1.30	0.75	0.45
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–1.86	24.71	–0.08	0.94
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–19.45	22.27	–0.87	0.38
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	0.29	1.19	0.25	0.80

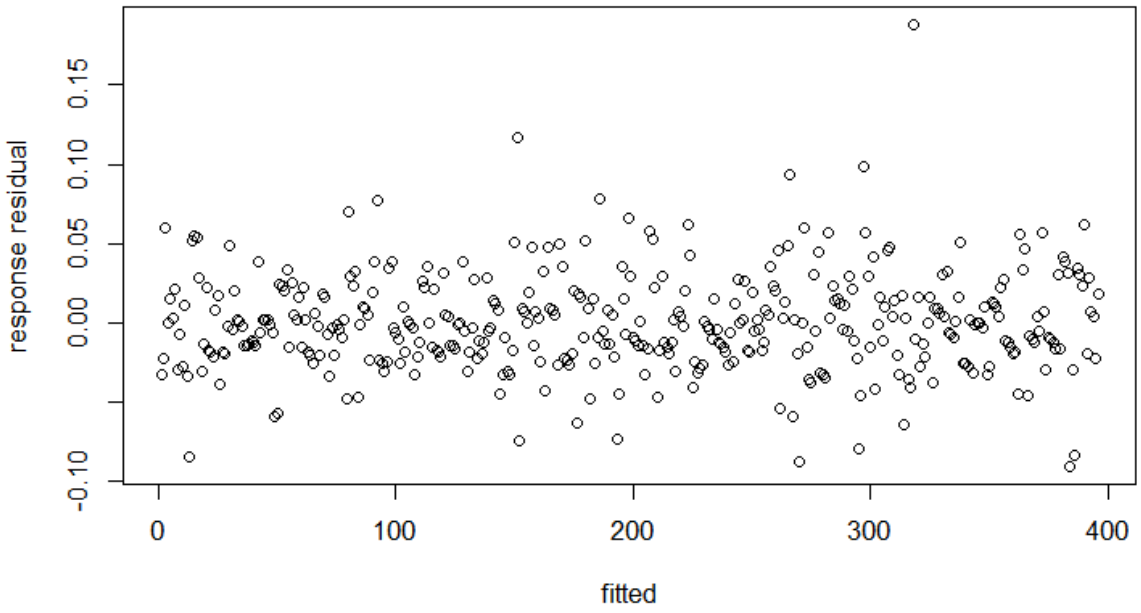

Figure 2 Fitted values and data residuals: tree mortality

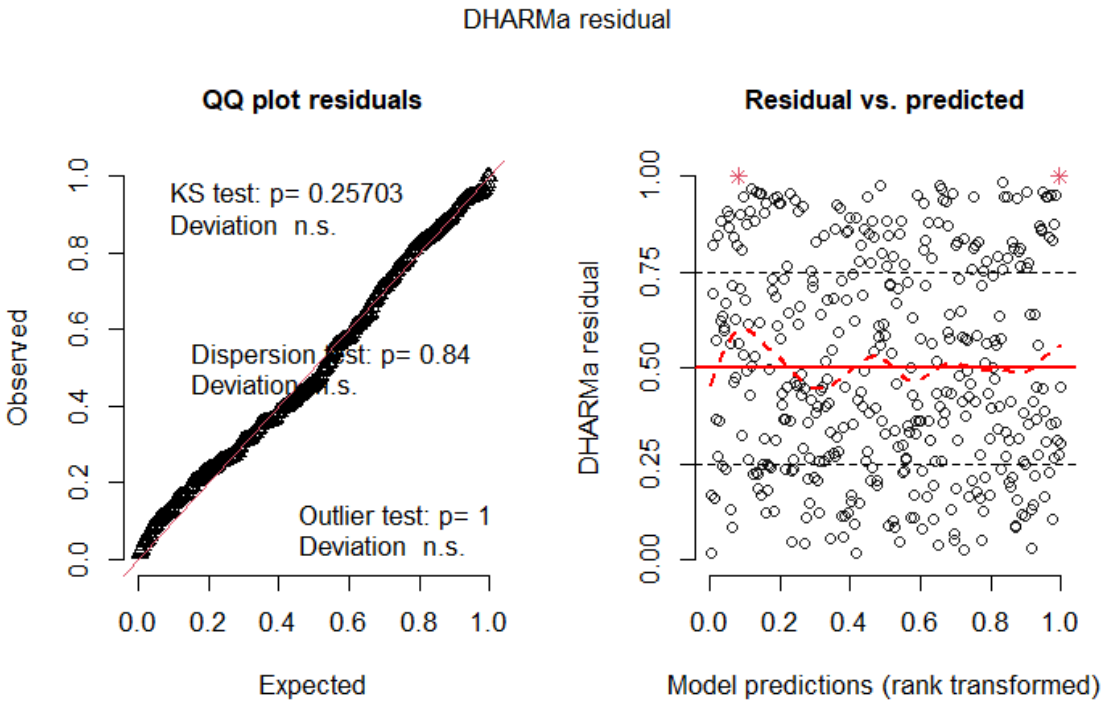

Figure 3 Simulated randomised quantile residuals: tree mortality

3.2 Large tree mortality

Table 4 Model fitting summary: large tree mortality

Response	Proportion of all large trees (≥ 80 centimetres diameter at breast height) per 2-hectare subplot that were dead Modelled as the ratio of large dead to large live trees
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Binomial
Outliers removed	None
Reported model formula	3_3way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 3 survey years)
Other transformations compared	None
Other models attempted	Binomial: • 4_way: Model convergence problem; non-positive-definite Hessian matrix • 3_3way: No warnings but failed bootstrapped simulations

	No other distributions compared
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (6% of 999)

Model summary 2 Large tree mortality

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	–1.13	0.20	–5.68	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–0.29	1.46	–0.20	0.84
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	0.90	1.09	0.82	0.41
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–1.56	2.23	–0.70	0.48
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–15.29	20.30	–0.75	0.45
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	0.78	2.18	0.36	0.72
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–1.18	0.85	–1.38	0.17
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–5.98	11.85	–0.50	0.61
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	2.51	10.88	0.23	0.82
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	0.13	0.74	0.18	0.86
site.qualitySQ2	0.37	0.28	1.31	0.19
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	0.19	2.02	0.09	0.93
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–0.85	2.15	–0.40	0.69
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	5.72	3.19	1.79	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	32.92	32.09	1.03	0.30
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–1.52	2.84	–0.54	0.59
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–1.90	1.33	–1.43	0.15
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	5.94	18.36	0.32	0.75
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–12.90	17.92	–0.72	0.47
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	0.09	1.48	0.06	0.95

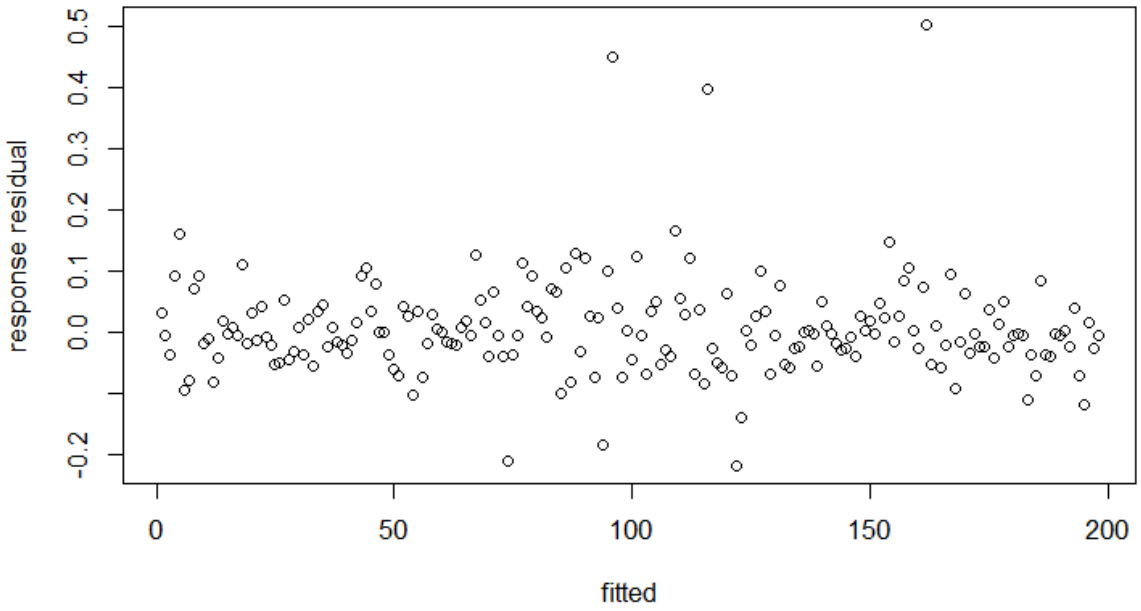

Figure 4 Fitted values and data residuals: large tree mortality

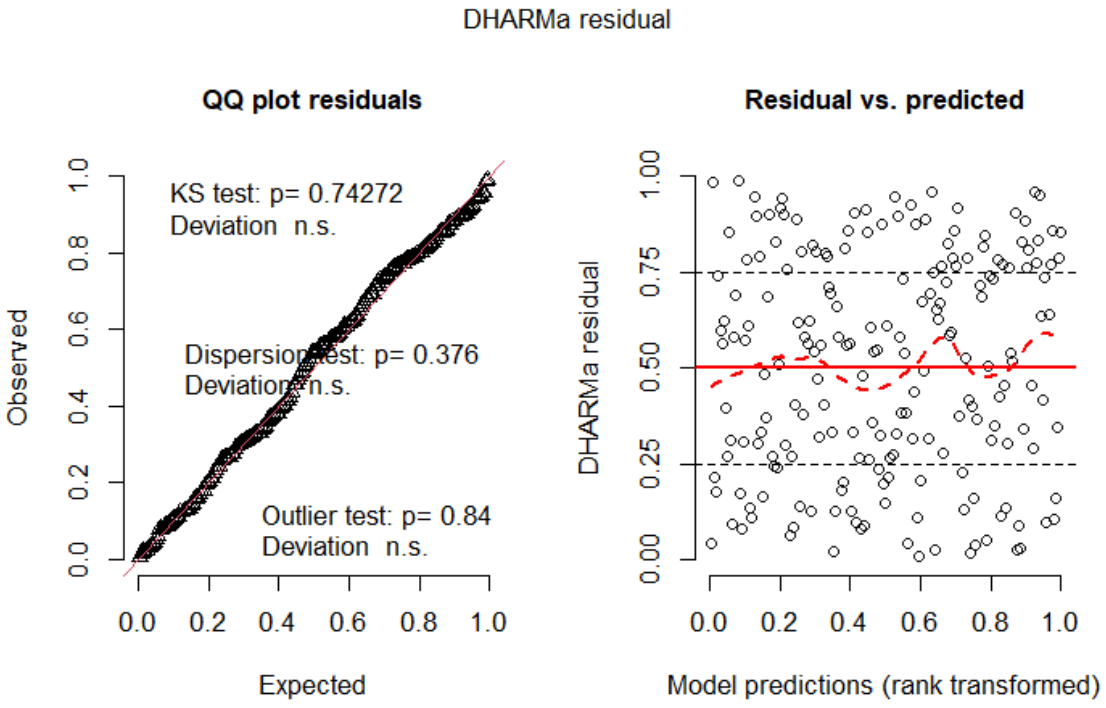

Figure 5 Simulated randomised quantile residuals: large tree mortality

4. Model summaries: Tree growth

4.1 Tree diameter growth rates

Table 5 Model fitting summary: tree growth rate by tree size

Response	Average growth per year – change in tree diameter at breast height in millimetres between initial and most recent surveys, divided by the number of decimal years passed between survey dates Continuous positive variable
Response transformation used	None
R package and function	lmer function in lme4 package
Distribution used	Gaussian
Outliers removed	Two: One value of –26 per year and one value of 55 mm per year
Reported model formula	4_3way_outlier = lmer(growth.per.year ~ poly(cbind(thinning, initSD.log, diameter.first.m), 2) * site.quality + thinning:initSD.log:diameter.first.m + (1|site) + (1|siteplot)
Random factors	site (a factor over 22 sites) 9 ha plot (a factor over 66 plots)
Other transformations compared	3_3_way_Log(var + 27): fit was worse than reported model
Other models attempted	• 4_way: Model converged but failed residual tests • 3_way_nosite: Model converged but failed residual tests
Confidence comments	Moderate confidence: • 2.7% boundary fit warnings; 0.1% model failures out of 999 simulations • Data were clustered around zero with long tails • Failed the Skewness-Kurtosis test • Failed the outlier test • Slight fan shape in the randomised quantile residuals

Model summary 3 Average tree growth rate by tree size

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	10.50	3.66	1907.20	2.87	0.00
poly(cbind(thinning, initSD.log, diameter.first.m), 2)1.0.0	214.51	135.72	1901.07	1.58	0.11
poly(cbind(thinning, initSD.log, diameter.first.m), 2)2.0.0	–16.73	11.81	50.11	–1.42	0.16
poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.1.0	44.16	17.69	129.75	2.50	0.01
poly(cbind(thinning, initSD.log, diameter.first.m), 2)1.1.0	1372.44	841.68	74.97	1.63	0.11
poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.2.0	12.50	13.84	48.83	0.90	0.37
poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.0.1	69.07	69.03	1894.40	1.00	0.32
poly(cbind(thinning, initSD.log, diameter.first.m), 2)1.0.1	3448.02	2649.31	1893.00	1.30	0.19
poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.1.1	330.60	261.26	1879.20	1.27	0.21

poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.0.2	3.47	4.27	1875.78	0.81	0.42
site.qualitySQ2	–1.67	0.51	25.09	–3.28	0.00
poly(cbind(thinning, initSD.log, diameter.first.m), 2)1.0.0:site.qualitySQ2	31.01	16.41	41.36	1.89	0.07
poly(cbind(thinning, initSD.log, diameter.first.m), 2)2.0.0:site.qualitySQ2	9.14	19.58	51.89	0.47	0.64
poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.1.0:site.qualitySQ2	–19.21	20.75	54.12	–0.93	0.36
poly(cbind(thinning, initSD.log, diameter.first.m), 2)1.1.0:site.qualitySQ2	–238.99	951.63	45.40	–0.25	0.80
poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.2.0:site.qualitySQ2	–18.35	17.08	49.15	–1.07	0.29
poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.0.1:site.qualitySQ2	10.03	6.58	1898.38	1.52	0.13
poly(cbind(thinning, initSD.log, diameter.first.m), 2)1.0.1:site.qualitySQ2	77.61	301.63	1882.17	0.26	0.80
poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.1.1:site.qualitySQ2	–390.40	292.37	1892.42	–1.34	0.18
poly(cbind(thinning, initSD.log, diameter.first.m), 2)0.0.2:site.qualitySQ2	10.84	6.07	1886.63	1.79	0.07
thinning:initSD.log:diameter.first.m	–4.80	2.98	1892.84	–1.61	0.11

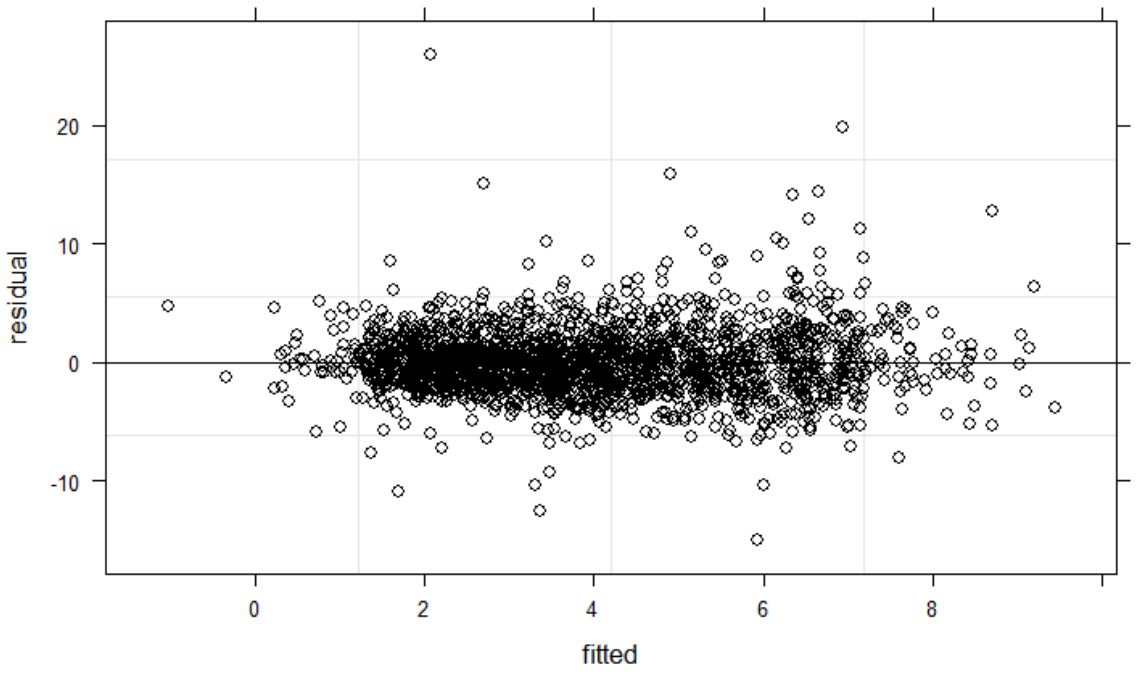

Figure 6 Fitted values and data residuals: average tree growth rate by tree size

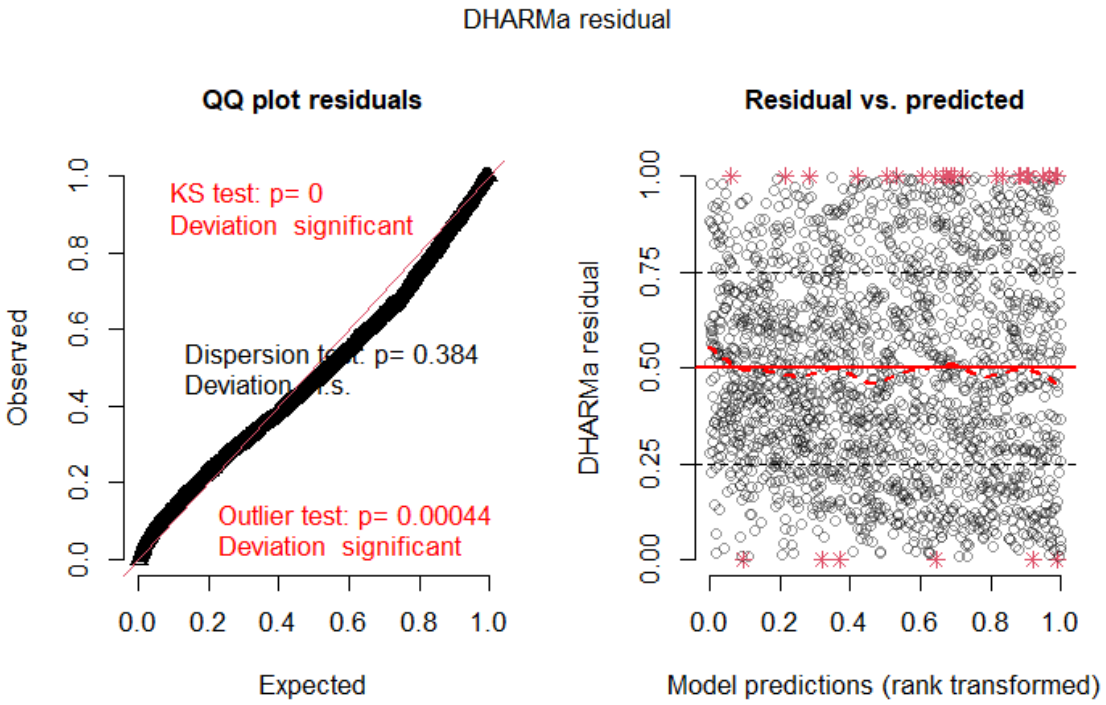

Figure 7 **Simulated randomised quantile residuals: average tree growth rate by tree size**

4.2 Tree height growth rates

Table 6 **Model fitting summary: tree height**

Response	Height of up to 10 trees in the tallest stratum (excluding saplings in the mid-stratum) per 0.04-hectare subplot, measured in metres Data for 2020–21 and 2021–22 only Continuous positive variable
Response transformation used	None
R package and function	lmer from the lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model formula	4_3way
Random factors	Siteplot (a factor over 66 plots) Subplot (a factor over 198 subplots that were each surveyed twice) (No random effect of tree because the same trees were not measured each year)
Other transformations compared	None
Other models attempted	Gaussian: • 4_way: Model failed to converge

	• 3_way: Boundary fit is singular • 3_way_nosite: Boundary fit is singular • 3_way_noyear.factor: Boundary fit is singular • 3_way_nosite_noyear.factor: Model converged but >22% failure in bootstrapped simulations • 3_way_noyrs.elapsed: Model converged but >20% failure in bootstrapped simulations No other distributions compared
Confidence comments	Moderate confidence: • No fit warnings • Conformed to all skewness-kurtosis and dispersion tests but failed outlier test • Some non-convergence warnings in bootstrapped prediction interval simulations (8.2% of 500)

Model summary 4 Tree height

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	43.86	19.17	2172.89	2.29	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	1185.12	958.46	2174.10	1.24	0.22
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–50.28	17.44	168.59	–2.88	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	81.21	62.21	1559.78	1.31	0.19
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	4984.06	2991.01	1614.38	1.67	0.10
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	12.17	23.17	176.27	0.53	0.60
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	116.53	143.26	2171.64	0.81	0.42
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	9282.95	7390.19	2174.66	1.26	0.21
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	2147.13	753.76	1544.52	2.85	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	8.05	8.06	1965.61	1.00	0.32
site.qualitySQ2	–2.94	0.75	25.63	–3.90	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	15.70	27.67	209.65	0.57	0.57
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	67.58	29.20	158.25	2.31	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–14.22	31.51	102.32	–0.45	0.65
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–2604.50	1715.02	211.87	–1.52	0.13
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	18.97	28.15	164.08	0.67	0.50
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	19.02	16.69	1400.27	1.14	0.25
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–422.14	783.95	2169.76	–0.54	0.59
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–2257.11	875.87	1760.42	–2.58	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–18.22	15.24	2084.47	–1.20	0.23
thinning:initSD.log:yrs.elapsed	–2.71	2.29	2173.47	–1.19	0.24

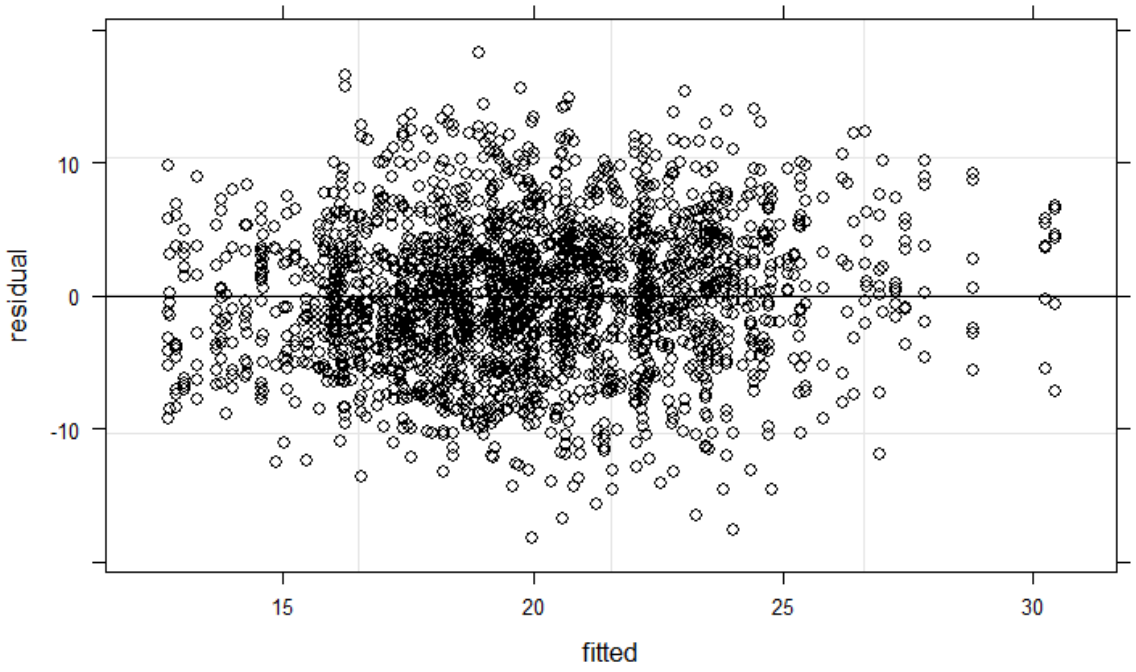

Figure 8 Fitted values and data residuals: tree mortality

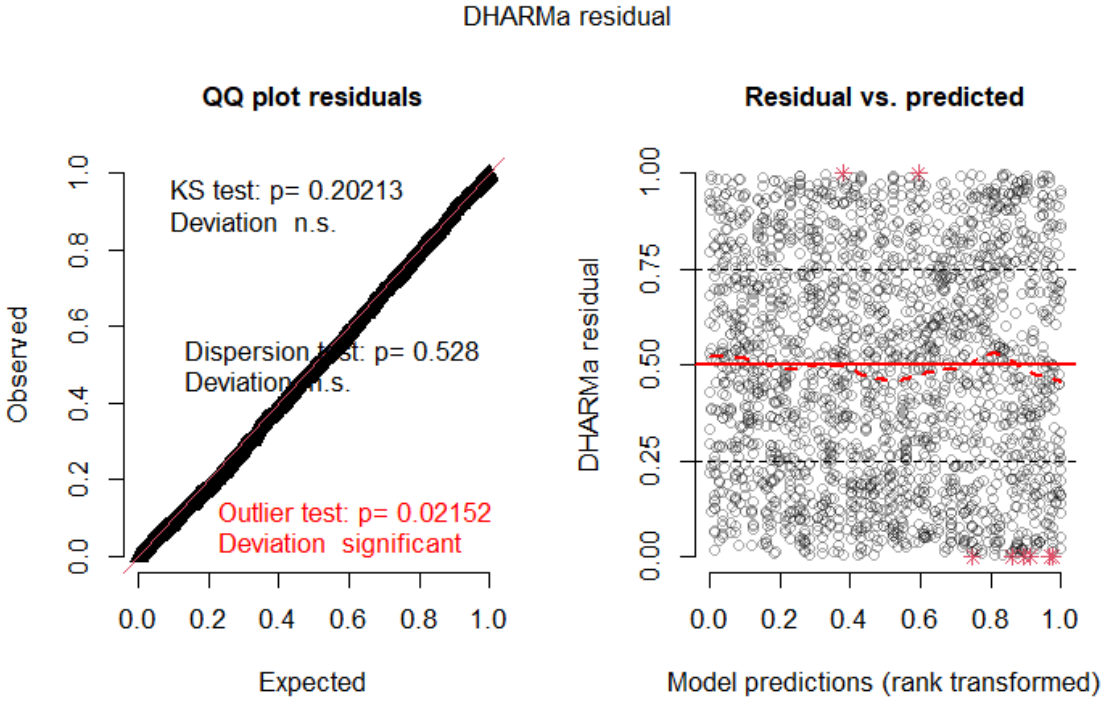

Figure 9 Simulated randomised quantile residuals: tree mortality

5. Model summaries: Tree size class structure

5.1 Count of large live trees

Table 7 Model fitting summary: count of large live trees

Response	Number of large live trees (≥80 centimetres diameter at breast height) per 2-hectare subplot Positive integer variable
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Poisson
Outliers removed	None
Reported model formula	3_3way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 3 survey years)
Other transformations compared	None
Other models attempted	Gaussian: • 4_way: Boundary (singular) fit Negative Binomial, linear parameterisation: • 4_way: Residuals improved but model convergence problem; non-positive-definite Hessian matrix Negative Binomial, quadratic parameterisation • 4_way: Residuals improved but model convergence problem; non-positive-definite Hessian matrix Poisson: • 4_way: Model convergence problem; non-positive-definite Hessian matrix • 3_3way (Poisson): No warnings but failed bootstrapped simulations
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (9.5% of 999)

Model summary 5 Count of large live trees

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	3.11	0.09	34.32	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–1.33	0.74	–1.80	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–0.26	0.56	–0.46	0.65
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	0.05	1.34	0.04	0.97
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	11.78	10.24	1.15	0.25
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	0.89	1.24	0.72	0.47
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	3.89	0.42	9.19	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	0.48	5.78	0.08	0.93
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	4.67	5.30	0.88	0.38
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–1.20	0.37	–3.21	0.00
site.qualitySQ2	–0.80	0.13	–6.12	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	1.32	1.10	1.21	0.23
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–0.44	1.16	–0.38	0.71
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–2.73	1.76	–1.55	0.12
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–12.61	17.90	–0.70	0.48
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–2.36	1.61	–1.47	0.14
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–0.13	0.73	–0.17	0.86
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–5.70	9.32	–0.61	0.54
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–0.65	9.38	–0.07	0.94
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	0.62	0.76	0.82	0.41

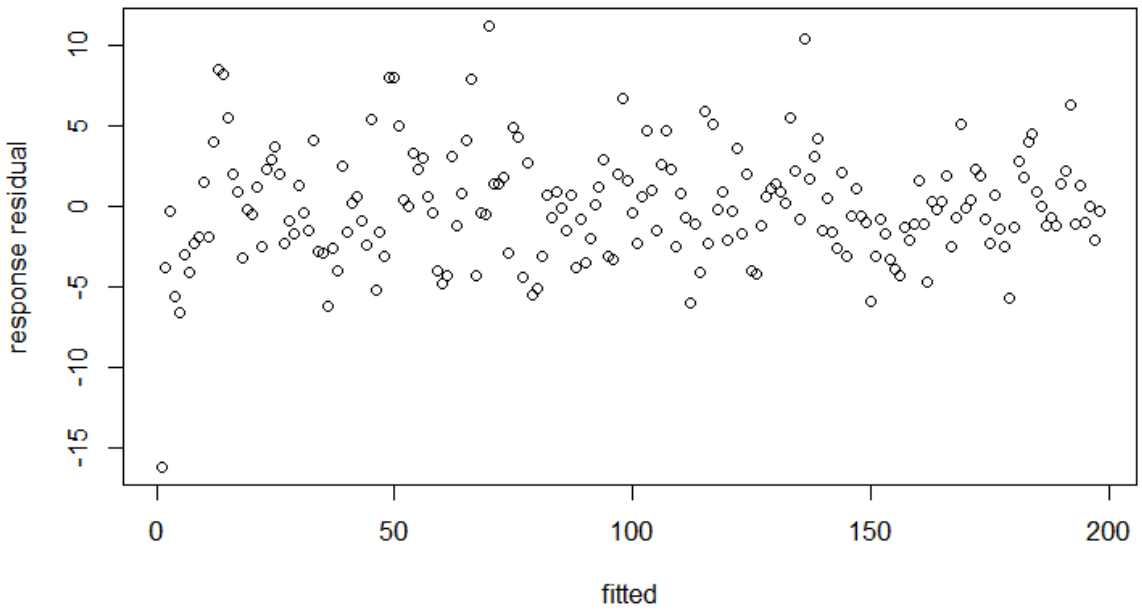

Figure 10 Fitted values and data residuals: count of large live trees

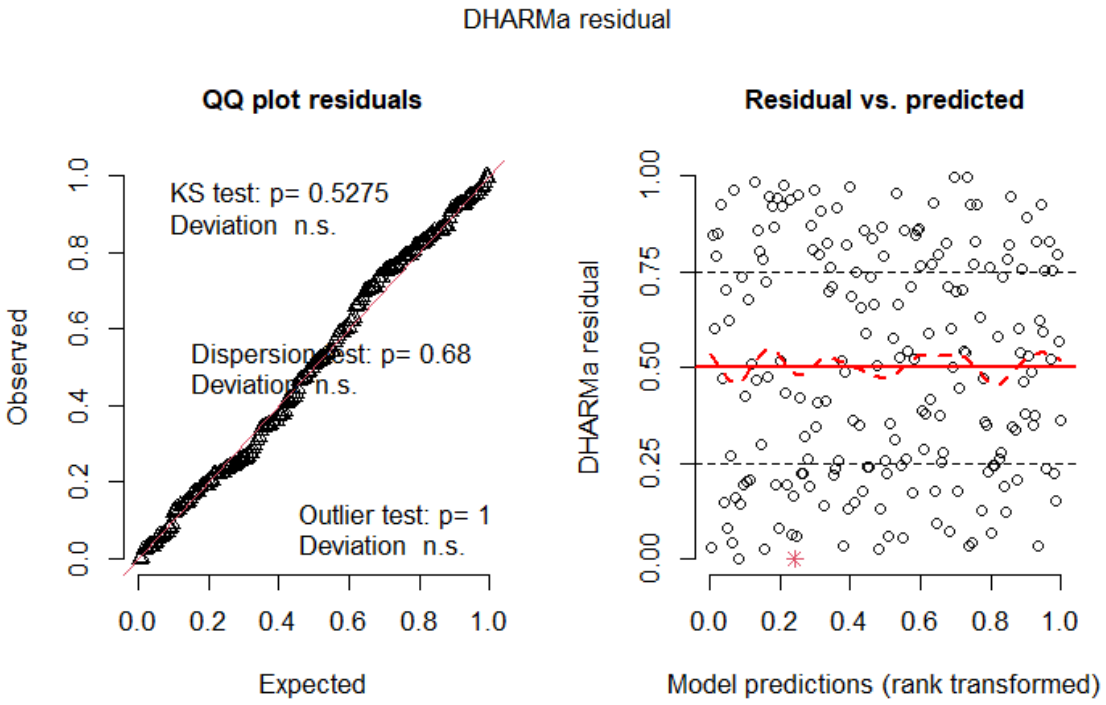

Figure 11 Simulated randomised quantile residuals: count of large live trees

5.2 Proportion of trees occurring in large diameter size classes

Table 8 Model fitting summary: Proportion of trees occurring in large diameter size classes

Response	Proportion of all trees that were large (≥80 centimetres diameter at breast height) per hectare Proportion variable
Response transformation used	Changed four zeroes to small value (0.001) to allow beta distribution
R package and function	glmmTMB function from glmmTMB package
Distribution used	Beta, with 'logit' link
Outliers removed	None
Reported model formula	3way without yrs.elapsed
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 3 survey years)
Other transformations compared	None
Other models attempted	Binomial: • 4_way noyrs.elapsed and year factor as fixed factor: Model failed to converge: non-positive definite Hessian

	• 4_way noyrs.elapsed, year factor as fixed factor and no site random effect: Model failed to converge: non-positive definite Hessian • 3_way noyrs.elapsed and year factor as a random effect: Model converges but fit not as ideal as the model reported Binomial (with initial stem density removed) • 3_way noyrs.elapsed and year factor as fixed factor: Model failed to converge: non-positive definite Hessian • 2_way noyrs.elapsed and year factor as fixed factor: Model converged but failed residual tests Gamma (without initial stem density): • 4_way without yrs.elapsed and year factor as fixed factor: Model failed to converge: non-positive definite Hessian • 3_way without yrs.elapsed and year factor as a random effect: No warnings, but predictions from bootstrapped simulations were unrealistic Beta: • 3_way noyrs.elapsed: Model converged but failed residual tests
Confidence comments	Moderate to high confidence: • No fit warnings • Some remnant patterns in residuals • Some non-convergence warnings in bootstrapped prediction interval simulations (4.1% of 999)

Model summary 6 Proportion of trees occurring in large diameter size classes

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr...z..
(Intercept)	–3.25	0.22	–14.74	0
poly(cbind(thinning, initSD.log), 2)1.0	5.2	0.89	5.86	0
poly(cbind(thinning, initSD.log), 2)2.0	1.7	0.76	2.25	0.02
poly(cbind(thinning, initSD.log), 2)0.1	–5.16	1.42	–3.62	0
poly(cbind(thinning, initSD.log), 2)1.1	–23.75	10.16	–2.34	0.02
poly(cbind(thinning, initSD.log), 2)0.2	–0.15	1.42	–0.11	0.92
site.qualitySQ2	–0.89	0.16	–5.39	0
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2	–1.01	0.93	–1.08	0.28
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2	1.16	1.33	0.87	0.38
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2	–3.22	2.02	–1.6	0.11
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2	2.17	17.39	0.13	0.9
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2	–1.21	1.78	–0.68	0.5

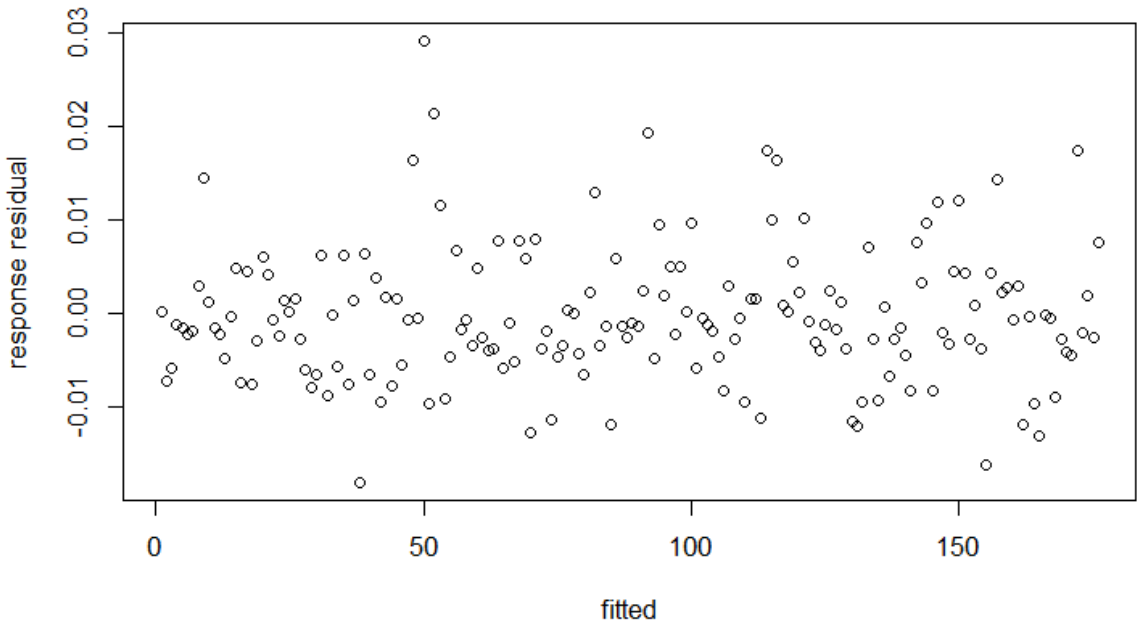

Figure 12 Fitted values and data residuals: proportion of trees occurring in large diameter size classes

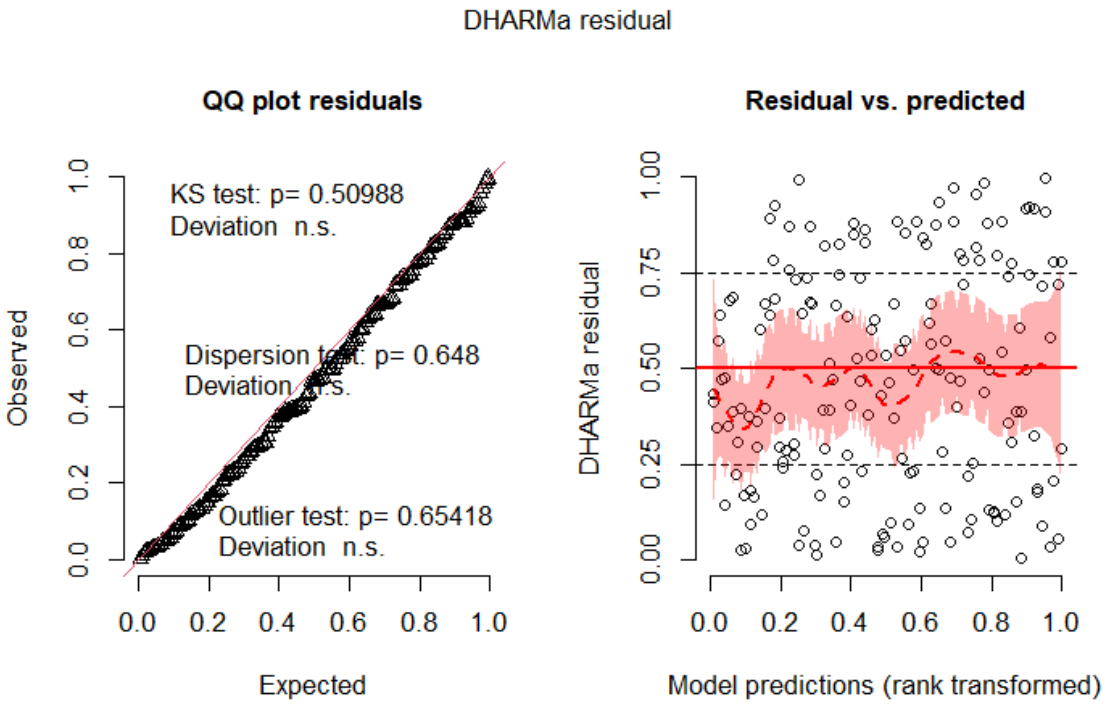

Figure 13 Simulated randomised quantile residuals: proportion of trees occurring in large diameter size classes

5.3 Model summaries: Coppice

Table 9 Model fitting summary: Abundance of coppiced stems on thinned plots (not including control plots)

Response	Count of total coppice stems > 1.37 metres in height arising from stumps and damaged or pushed over saplings per 0.1 hectare Data collected in 2020–21 only Positive integer variable
Response transformation used	None
R package and function	glmmTMB from package glmmTMB
Distribution used	Negative binomial with linear parameterisation and log link
Outliers removed	None – but all control plots, which all had zero coppice, excluded
Reported model formula	3_3way
Random factors	Siteplot (a factor over 66 plots)
Other transformations compared	None
Other models attempted	Models including control plots: Negative binomial with quadratic parameterisation • 4_way: Model failed to converge – non-positive-definite Hessian matrix • 3_way: Model converges but higher AICc than reported model Negative binomial with linear parameterisation • 4_way: Model failed to converge – non-positive-definite Hessian matrix Poisson: • 4_way: Model failed to converge – non-positive-definite Hessian matrix • 3_way: Model converges but higher AICc than reported model Models excluding control plots: Negative binomial with linear parameterisation • 3_way: Model converges failed bootstrapped simulations
Confidence comments	Low to moderate confidence: - Passed all residual tests - Approximately 20% model convergence warnings in 999 bootstrapped simulations

Model summary 7 Abundance of coppiced stems

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr...z..
(Intercept)	4.92	1.06	4.64	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	12.11	4.49	2.7	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	17.19	13.14	1.31	0.19
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	13.68	5.41	2.53	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	216.2	165.64	1.31	0.19
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–3.24	3.32	–0.98	0.33
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	20.86	9.33	2.24	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	736.18	516.17	1.43	0.15
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	157.97	133.24	1.19	0.24
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	14.49	7.58	1.91	0.06
site.qualitySQ2	–1.3	1.09	–1.2	0.23
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	5.81	9.51	0.61	0.54
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–29.63	14.81	–2	0.05
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	9.25	7.71	1.2	0.23
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–158.21	177.26	–0.89	0.37
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	14.68	6.59	2.23	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–23.56	10.44	–2.26	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–591.3	532.29	–1.11	0.27
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–104.61	180.78	–0.58	0.56
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–0.79	8.49	–0.09	0.93

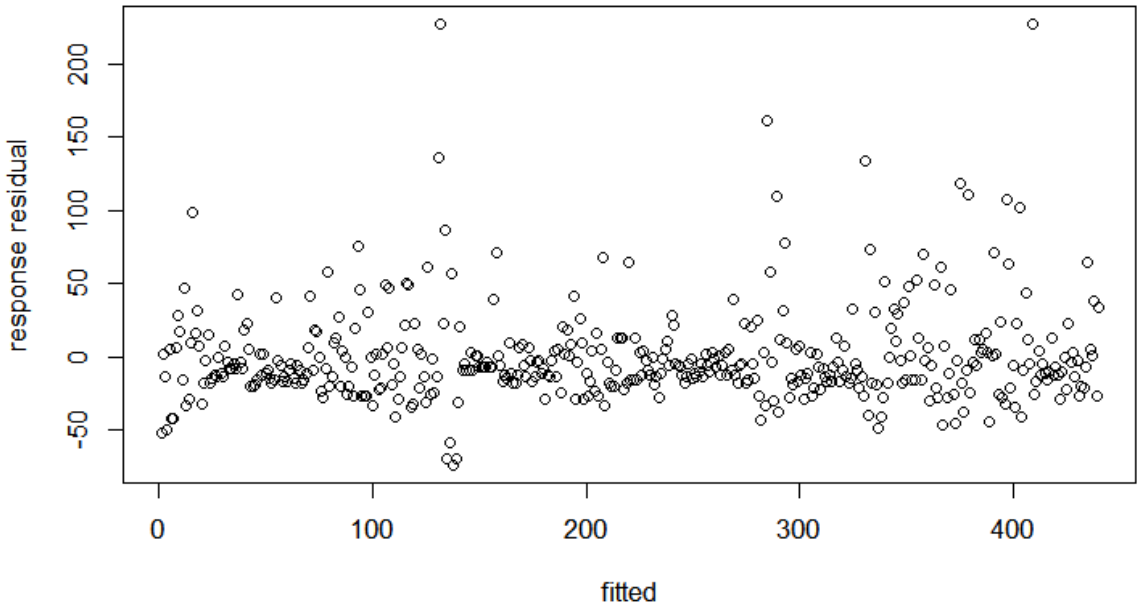

Figure 14 Fitted values and data residuals: abundance of coppiced stems

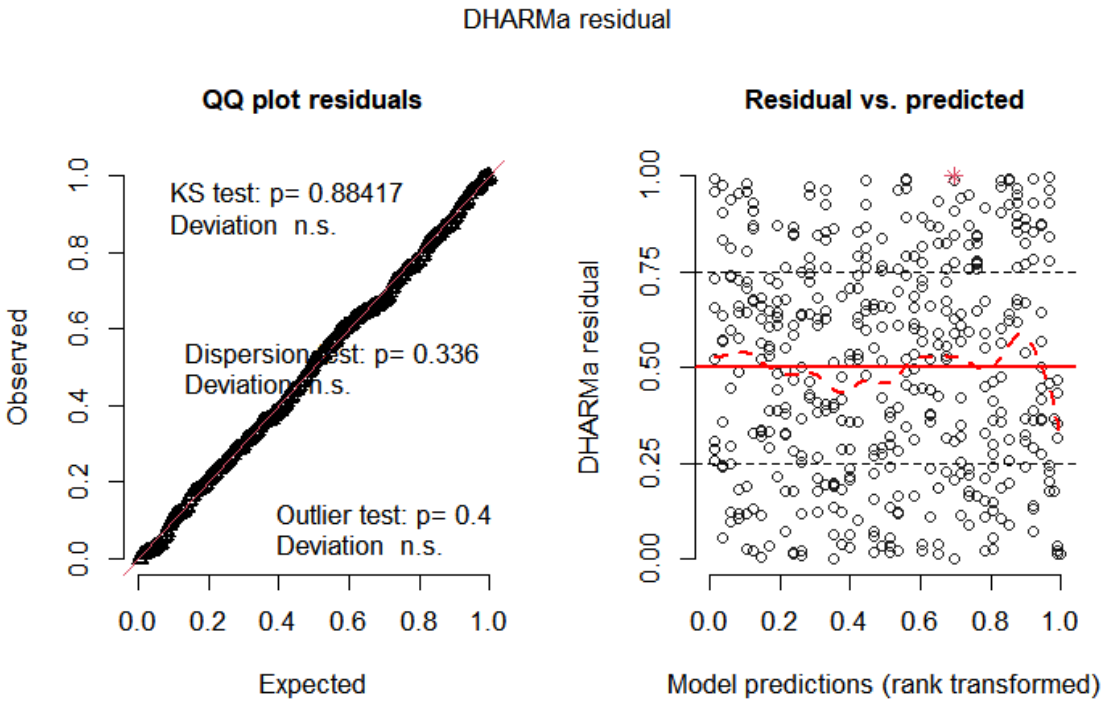

Figure 15 Simulated randomised quantile residuals: abundance of coppiced stems

6. Model summaries: Hollow-bearing tree development

6.1 Tree crown area

Table 10 Model fitting summary: tree crown area

Response	Area (m^2) of the tree crown of 30 permanently marked trees per 9-hectare plot Positive continuous variable
Response transformation used	Log(base e)
R package and function	lmer from the lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model formula	4_way
Random factors	Year.factor (a factor over 3 survey years) Site (a factor over 22 sites) Siteplot (factor over 66 plots) Tree (a factor for repeated measurements of each tree per siteplot)
Other transformations compared	None
Other models attempted	None
Confidence comments	Moderate to high confidence: • Some fanning in the Dunn-Smyth fitted values and residuals (Figure 16) • Passed all simulated residual tests • Fit warnings for 14% of 999 bootstrapped simulations • Very wide and overlapping confidence intervals inconsistent with statistical significance indicated by likelihood ratio tests

Model summary 8 Tree crown area

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	3.79	0.13	6.16	30.25	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	12.28	7.45	3933.71	1.65	0.1
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–0.34	0.73	3348.46	–0.47	0.64
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–1.67	3.35	65.24	–0.5	0.62
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	47.62	77.24	3692.28	0.62	0.54
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–4.51	3.32	57.21	–1.36	0.18

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	35.32	9.78	152.55	3.61	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	1595.79	880.01	3850.72	1.81	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	174.78	53.24	3971.47	3.28	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	0.11	0.63	2468.63	0.17	0.87
site.qualitySQ2	–0.33	0.11	158.22	–2.96	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–18.99	8.86	3957.77	–2.14	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	2.77	1.15	3834.66	2.41	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–6.25	4.45	65.51	–1.41	0.16
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–240.95	108.23	3967.46	–2.23	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	5.45	4.07	57.04	1.34	0.19
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–18.39	10.6	3953.85	–1.74	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–2031.81	1045.91	3954.35	–1.94	0.05
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–279.19	66.97	3973.13	–4.17	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–2.32	0.76	3535.19	–3.07	0
site.qualitySQ1:thinning:initSD.log:yrs.elapsed	–0.05	0.03	3858.11	–1.67	0.1
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	0.02	0.02	3826.19	0.94	0.34

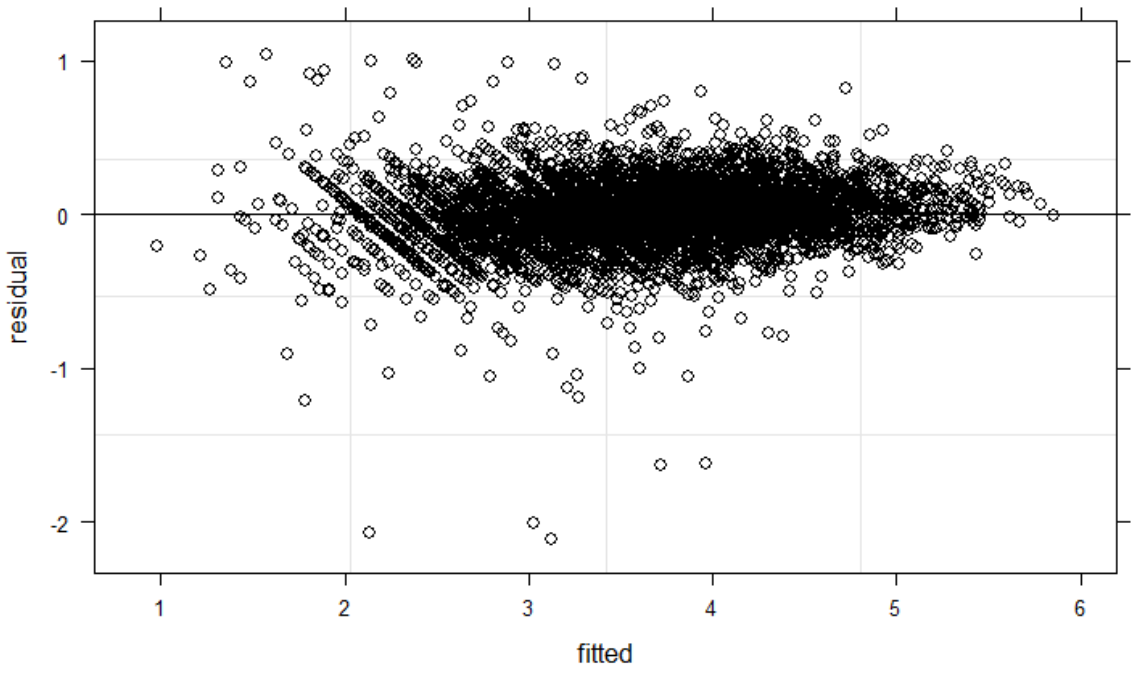

Figure 16 Fitted values and data residuals: tree crown area

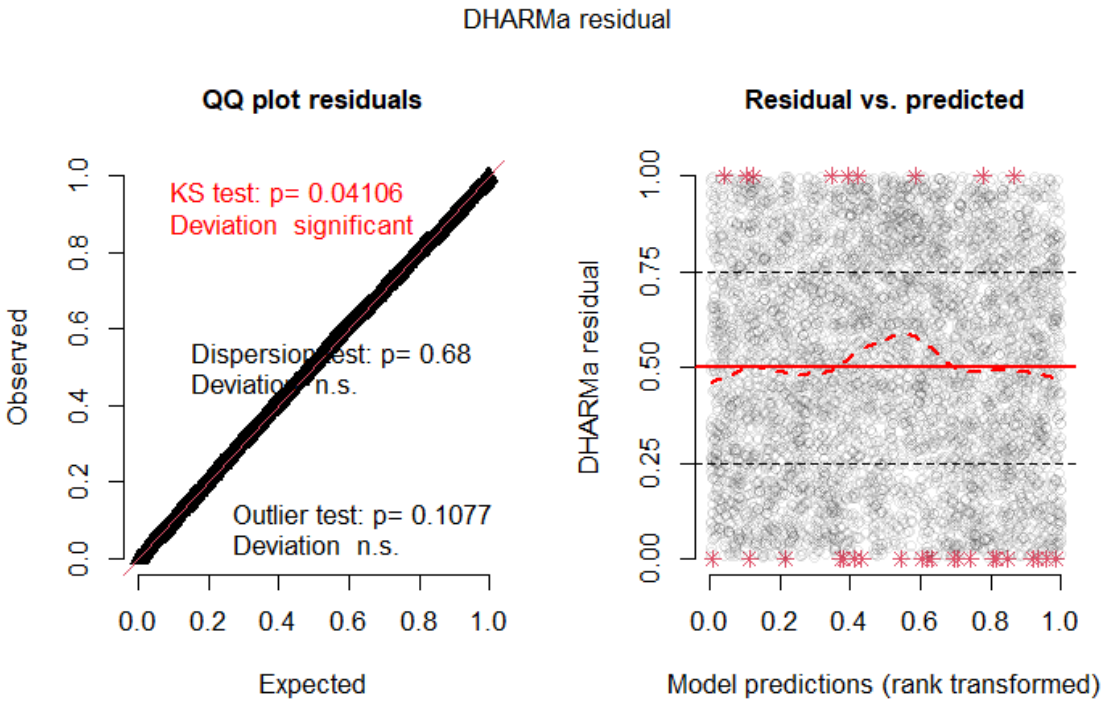

Figure 17 Simulated randomised quantile residuals: tree crown area

6.2 Count of hollow-bearing trees

Table 11 Model fitting summary: count of hollow-bearing trees

Response	Number of hollow-bearing trees per 2-hectare subplot Positive integer variable
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Poisson
Outliers removed	None
Reported model formula	4_3way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots)
Other transformations compared	None
Other models attempted	Gaussian: • 4_way: No warnings, but failed residual tests Negative Binomial, linear parameterisation: • 4_way: Model failed to converge: non-positive definite Hessian • 3_3way: No warnings, but bootstrapped simulations failed

	• 3_3way with no random effects for site: No warnings, but bootstrapped simulations failed • 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor: Model failed to converge: non-positive definite Hessian Negative Binomial, quadratic parameterisation • 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor: Non-positive definite Hessian • 3_3way: No warnings, but bootstrapped simulations failed • 3_3way with no random effect for site: No warnings, but bootstrapped simulations failed Poisson: • 4_way: Model failed to converge: non-positive definite Hessian • 4_way_noYrf: Model failed to converge: non-positive definite Hessian • 3_3way: No warnings, but failed residual tests • 3_3way with no random effects for site: No warnings, but failed residual tests • 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor: Model failed to converge: non-positive definite Hessian matrix • 3_way with yrs.elapsed removed and year factor changed from random factor to fixed factor: Model failed to converge: non-positive definite Hessian matrix
Confidence comments	High confidence: • No fit warnings • Conformed to all residual tests • No non-convergence warnings in bootstrapped prediction interval simulations (0% of 999)

Model summary 9 Count of hollowing bearing trees

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	2.96	0.23	12.94	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–3.24	3.61	–0.90	0.37
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	0.65	0.52	1.25	0.21
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–0.54	1.06	–0.51	0.61
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	1.52	9.52	0.16	0.87
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–0.13	0.96	–0.13	0.89
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–2.43	4.29	–0.57	0.57
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–72.19	77.66	–0.93	0.35
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–10.92	6.41	–1.70	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–1.06	0.36	–2.97	0.00
site.qualitySQ2	–0.28	0.17	–1.70	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	0.10	0.89	0.11	0.91
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–1.68	0.89	–1.89	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	0.36	1.40	0.26	0.80
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	6.76	13.74	0.49	0.62
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–0.37	1.18	–0.31	0.75
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–0.43	0.60	–0.71	0.48

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	16.05	8.88	1.81	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	6.20	7.90	0.79	0.43
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–0.78	0.63	–1.24	0.21
thinning:initSD.log:yrs.elapsed	0.06	0.08	0.78	0.43

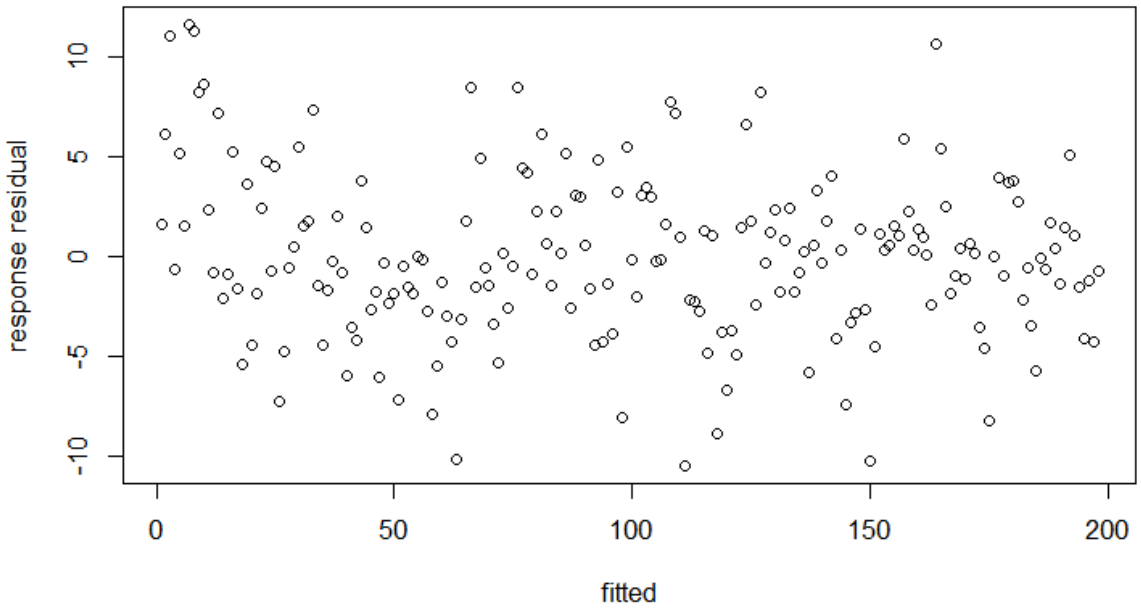

Figure 18 Fitted values and data residuals: count of hollow-bearing trees

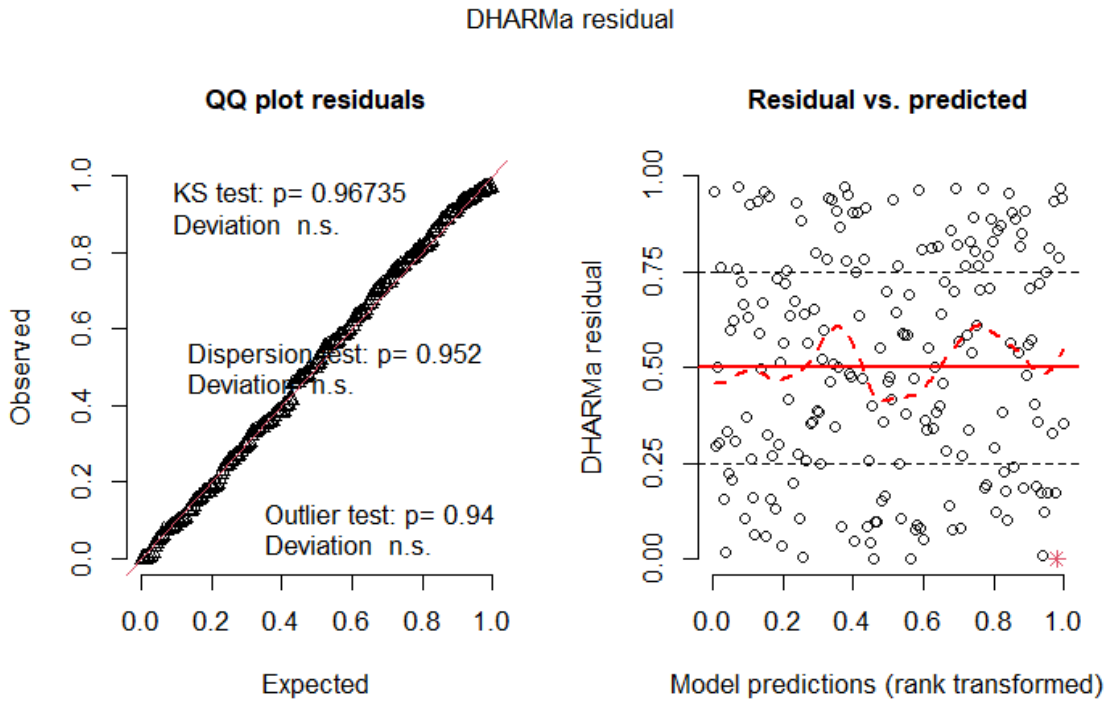

Figure 19 Simulated randomised quantile residuals: count of hollow-bearing trees

7. Model summaries: Tree canopy health

7.1 Individual tree crown extent

Table 12 Model fitting summary: tree crown extent

Response	Crown extent (proportion of potential crown that contains live foliage in 5% categories between 0% and 100%) assessed for 30 trees per 9-hectare plot, averaged for each plot Continuous positive variable
Response transformations used	None
R package and function	lmer function in lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model	4_way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 6 survey years)
Other transformations compared	None
Other models attempted	Models attempted without averaging across each plot (and included a random factor for tree) • 4_way (Gaussian): No warnings, but failed residual tests • 4_way (Beta): No warnings, but failed residual tests
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (3.8% of 500)

Model summary 10 Average crown extent

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	72.01	5.52	338.15	13.05	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–189.24	113.45	338.07	–1.67	0.10
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–3.48	7.40	307.02	–0.47	0.64
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–10.75	16.10	111.98	–0.67	0.51
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–81.05	207.44	353.93	–0.39	0.70
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	9.71	13.55	52.91	0.72	0.48
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–136.29	95.66	337.49	–1.42	0.16
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–3322.22	1992.58	334.03	–1.67	0.10
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–5.34	113.74	357.73	–0.05	0.96

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	16.78	6.18	202.72	2.71	0.01
site.qualitySQ2	8.58	6.60	341.33	1.30	0.19
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	258.25	135.70	331.05	1.90	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	6.08	11.87	326.98	0.51	0.61
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	9.58	21.31	109.14	0.45	0.65
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	56.20	288.51	358.52	0.19	0.85
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–8.68	16.65	53.34	–0.52	0.60
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	207.17	114.04	327.66	1.82	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	4490.24	2373.44	328.52	1.89	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	89.25	142.98	357.30	0.62	0.53
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–2.28	5.80	336.21	–0.39	0.69
thinning:initSD.log:yrs.elapsed	2.07	1.18	334.21	1.75	0.08
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	–2.59	1.42	328.22	–1.82	0.07

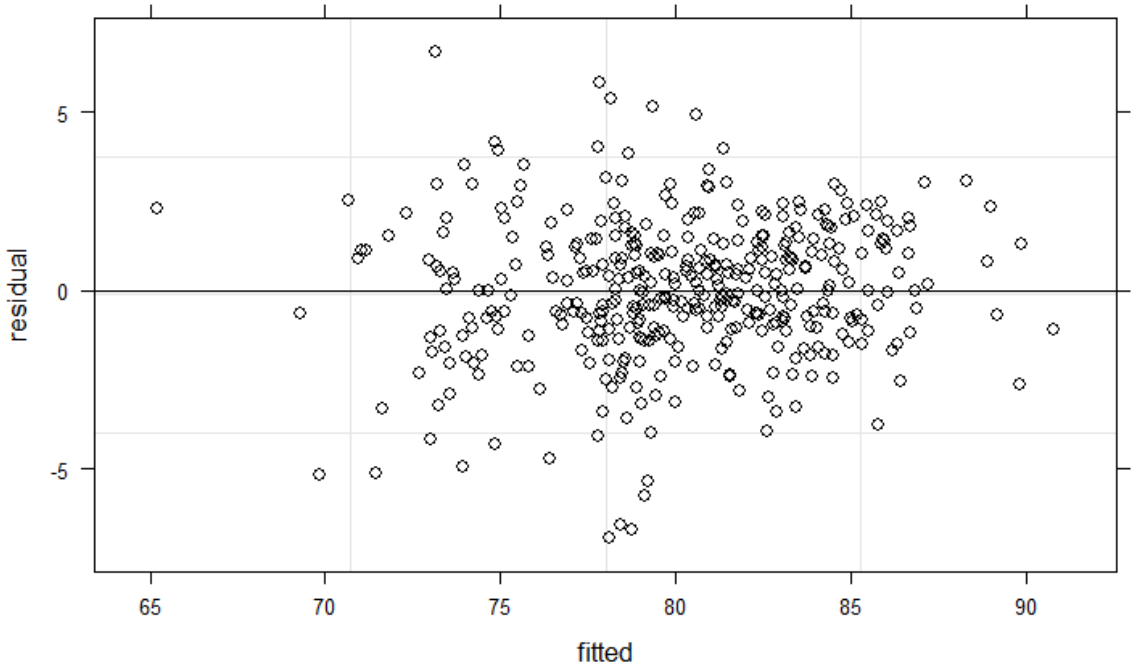

Figure 20 Residuals vs fixed effects: average crown extent

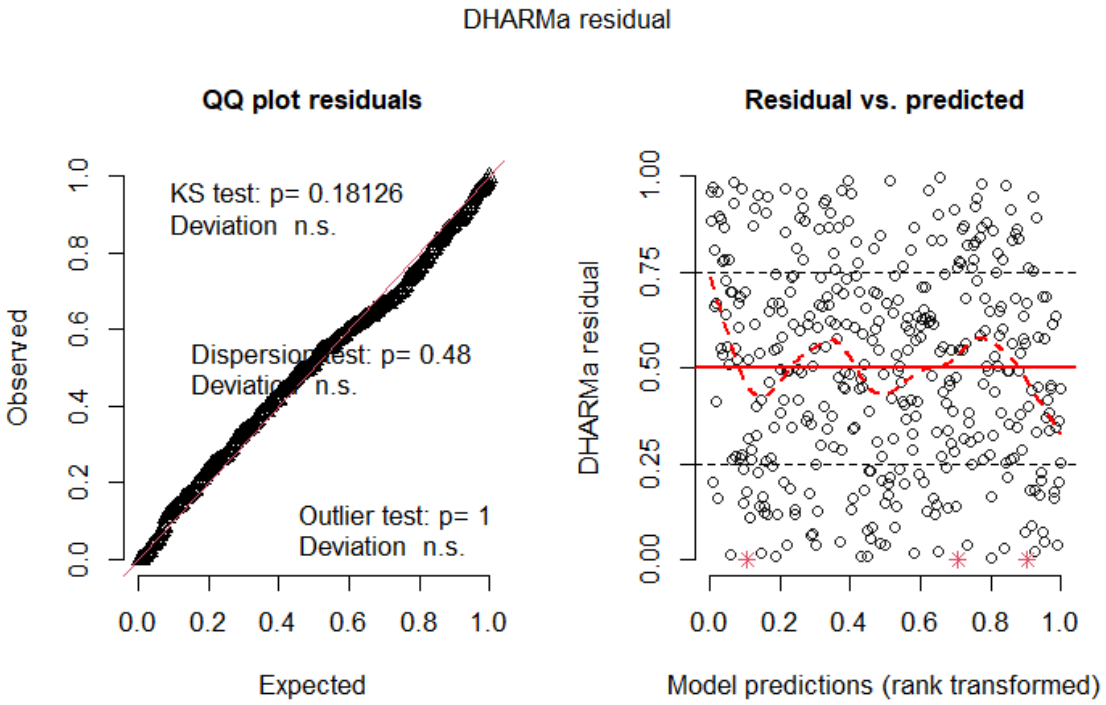

Figure 21 Simulated randomised quantile residuals: average crown extent

7.2 Remotely sensed canopy cover

Table 13 Model fitting summary: remotely sensed foliage projective cover

Response	Foliage projective cover (derived from Landsat images) A median of up to 9 values (from a 30 x 30 m pixel) per 9-hectare plot Continuous positive variable
Response transformations used	None
R package and function	lmer function in lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model	4_way
Random factors	Siteplot (a factor over 66 plots)
Other transformations compared	None
Other models attempted	Gaussian • 4_way: Failed to converge • 4_way with random effect of year.factor removed but site retained: No warnings but more than 10% bootstrap simulations failed.

Confidence comments	Moderate to high confidence • No fit warnings • Failed the Kurtosis-Skewness test, with minor deviations from expected • Zero warnings or failures out of 999 bootstrap iterations

Model summary 11 Remotely sensed foliage projective cover

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	0.377696	0.063879	6605.548	5.912702	3.53E-09
poly(cbind(thinning, initSD.log, Pass), 2)1.0.0	–6.59557	6.623015	6707.775	–0.99586	0.319356
poly(cbind(thinning, initSD.log, Pass), 2)2.0.0	–1.4901	0.210827	4733.486	–7.06785	1.80E-12
poly(cbind(thinning, initSD.log, Pass), 2)0.1.0	0.45694	0.796296	131.9527	0.573832	0.567059
poly(cbind(thinning, initSD.log, Pass), 2)1.1.0	–61.9744	46.2125	6684.342	–1.34107	0.179942
poly(cbind(thinning, initSD.log, Pass), 2)0.2.0	0.054264	0.687672	59.74914	0.07891	0.937368
poly(cbind(thinning, initSD.log, Pass), 2)0.0.1	–2.11222	2.982463	6705.059	–0.70821	0.478836
poly(cbind(thinning, initSD.log, Pass), 2)1.0.1	–285.526	315.0927	6707.329	–0.90617	0.364881
poly(cbind(thinning, initSD.log, Pass), 2)0.1.1	41.05834	15.72068	6580.251	2.61174	0.009029
poly(cbind(thinning, initSD.log, Pass), 2)0.0.2	1.200648	0.141971	6665.544	8.457	3.34E-17
site.qualitySQ2	–0.20511	0.077996	6553.844	–2.62979	0.008564
CosTime	–0.05718	0.001448	6648.051	–39.4926	1.28E-306
SinTime	–0.00156	0.0013	6647.142	–1.20246	0.229228
poly(cbind(thinning, initSD.log, Pass), 2)1.0.0:site.qualitySQ2	–10.7226	8.044792	6704.961	–1.33286	0.182622
poly(cbind(thinning, initSD.log, Pass), 2)2.0.0:site.qualitySQ2	0.656202	0.349021	4662.446	1.880121	0.060154
poly(cbind(thinning, initSD.log, Pass), 2)0.1.0:site.qualitySQ2	–1.28668	1.025856	120.456	–1.25425	0.212179
poly(cbind(thinning, initSD.log, Pass), 2)1.1.0:site.qualitySQ2	–69.3725	58.90165	6707.864	–1.17777	0.238931
poly(cbind(thinning, initSD.log, Pass), 2)0.2.0:site.qualitySQ2	–0.55843	0.846455	59.70655	–0.65972	0.511968
poly(cbind(thinning, initSD.log, Pass), 2)0.0.1:site.qualitySQ2	–6.27833	3.607688	6701.322	–1.74026	0.081859
poly(cbind(thinning, initSD.log, Pass), 2)1.0.1:site.qualitySQ2	–561.755	377.9871	6704.293	–1.48618	0.13728
poly(cbind(thinning, initSD.log, Pass), 2)0.1.1:site.qualitySQ2	–56.0824	19.60504	6594.523	–2.86061	0.004242
poly(cbind(thinning, initSD.log, Pass), 2)0.0.2:site.qualitySQ2	0.575359	0.202478	6669.318	2.841589	0.004503
thinning:initSD.log:Pass	0.000335	0.000451	6706.816	0.740953	0.458748
site.qualitySQ2:thinning:initSD.log:Pass	0.000844	0.000548	6703.263	1.541329	0.123284

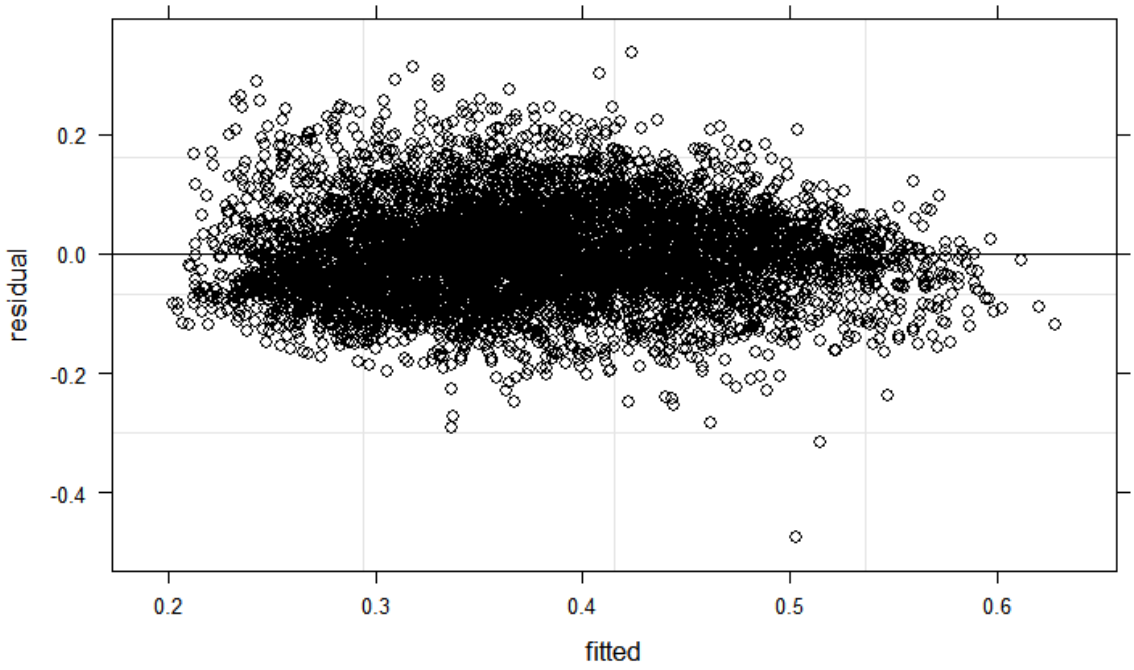

Figure 22 Residuals vs fixed effects: remotely sensed foliage projective cover

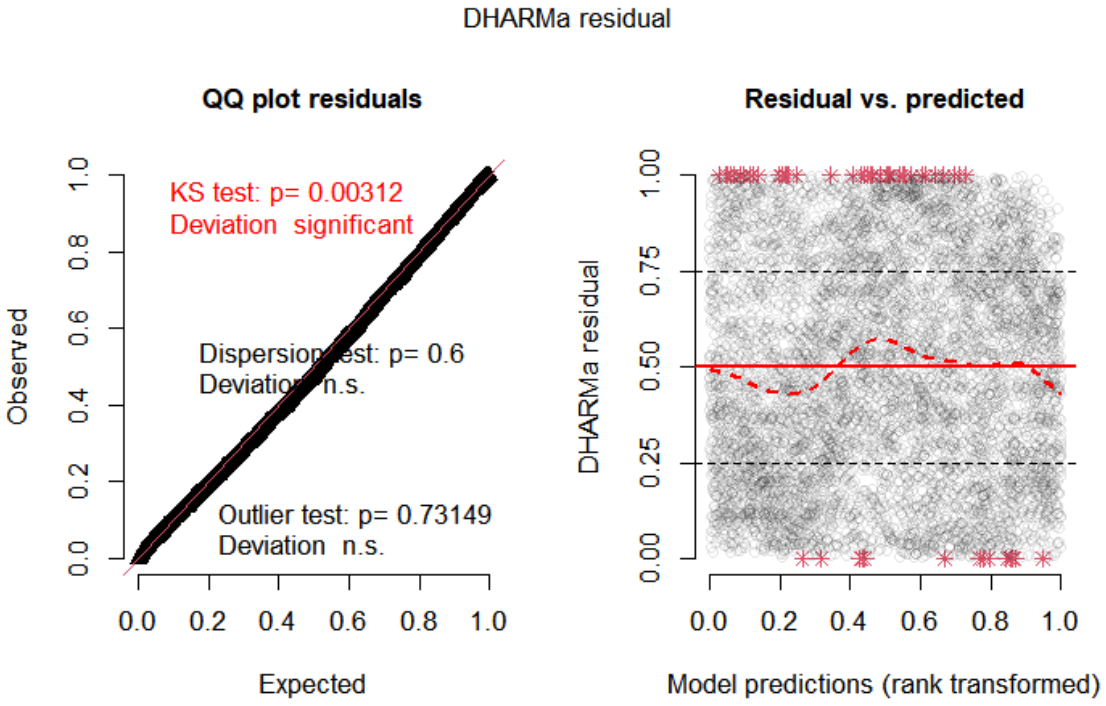

Figure 23 Simulated randomised quantile residuals: remotely sensed foliage projective cover

8. Model summaries: Recruitment

8.1 Germinant occurrence

Table 14 Model fitting summary: germinant presence–absence and germinant abundance

Response	Presence–absence for germinant presence in each 0.04-hectare subplot Binomial variable
Response transformation used	None
R package and function	glmer function from the lme4 package and glmmTMB function from the glmmTMB package
Distribution used	See 'other models attempted' below
Outliers removed	None
Reported model formula	No model reported
Random factors	NA
Other transformations compared	None
Other models attempted	Presence–absence data with a binomial distribution: • 4_way with random effects of site, siteplot, subplot and year.factor: model failed to converge • 3_way with random effects of site, siteplot, subplot and year.factor: model is nearly unidentifiable: large eigenvalue ratio • 3_way with random effects of site, siteplot, subplot: model failed to converge • 3_way with random effects of siteplot and subplot: model failed to converge • 3_way with random effects of siteplot: this model converged but failed 98% of bootstrapped simulations • 4_way with no years.elapsed and year.factor as fixed effect and all combinations of random effects: model failed to converge • 3_way with no years.elapsed and year.factor as fixed effect and siteplot and subplot as random effects: model failed to converge Presence–absence, with zero-inflated Poisson, negative binomial (linear parameterisation) and negative binomial (quadradic parameterisation): • 3_way with no years.elapsed and year.factor as fixed effect with siteplot as random effect: All models failed to converge – non-positive-definite Hessian matrix. Presence–absence on a simplified dataset of years 2020–21 and 2021–22 data only: • 3_way with no yrs.elapsed and year.factor as fixed effect with siteplot and subplot as random effect: model converged but failed bootstrapped simulations.

Confidence comments	NA

8.2 Sapling abundance

Table 15 Model fitting summary: sapling abundance

Response	Number of saplings present in each 0.04 ha subplot Positive integer variable
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Zero-inflated Poisson
Outliers removed	None
Reported model formula	4_3way
Random factors	Year.factor (a factor over 6 years) Subplot (a factor over 198 subplots that were surveyed annually)
Other transformations compared	None
Other models attempted	Poisson: • 4_way with year.factor, site, siteplot and subplot as random effects: Model failed to converge – non-positive-definite Hessian matrix Zero-inflated negative binomial, linear parameterisation • 4_way with year.factor, site, siteplot and subplot as random effects: Model failed to converge – non-positive-definite Hessian matrix • 3_way with year.factor, site, siteplot and subplot as random effects:Model fits but fails residual tests • 3_way with year.factor, siteplot and subplot as random effects: Model failed to converge – non-positive-definite Hessian matrix Zero-inflated negative binomial, quadratic parameterisation: • 4way with year.factor, site, siteplot and subplot as random effects: Model failed to converge – non-positive-definite Hessian matrix • 3_way with year.factor, site, siteplot and subplot as random effects: Model failed to converge – non-positive-definite Hessian matrix • 3_way with year.factor, siteplot and subplot as random effects: Model failed to converge – non-positive-definite Hessian matrix Zero-inflated Poisson: • 4_way with year.factor, site, siteplot and subplot as random effects: Model failed to converge – non-positive-definite Hessian matrix • 4_way with only subplot as random effect: Model failed to converge – non-positive-definite Hessian matrix • 3_way with year.factor, site, siteplot and subplot as random effects: Model fits but fails bootstrapped simulations • 3_way with year.factor, siteplot and subplot as random effects: Model fits but fails bootstrapped simulations and residual tests

	• 3_way with yrs.elapsed removed as a fixed effect and year.factor as fixed effect with site, siteplot and subplot as random effects: Model failed to converge – non-positive-definite Hessian matrix
Confidence comments	Low to moderate confidence: • No fit warnings • Failed the Kurtosis-Skewness test, with minor deviations from expected • Few non-convergence warnings in bootstrapped prediction interval simulations (19 out of 999) • Some remnant patterns in residuals • Confidence intervals very narrow for some predictions and very wide for others

Model summary 12 Sapling abundance

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr...z..
(Intercept)	1.01	0.5	2.02	0.04
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–37.19	16.63	–2.24	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–0.37	1.16	–0.32	0.75
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	13.14	5.51	2.39	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–304.77	70.21	–4.34	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–1.04	5.64	–0.18	0.85
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–8.62	15.43	–0.56	0.58
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–440	505.19	–0.87	0.38
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	47.76	25.4	1.88	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–5.2	1	–5.23	0
site.qualitySQ2	–0.36	0.21	–1.75	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–3.55	2.33	–1.52	0.13
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–16.94	1.83	–9.23	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	28.22	7.14	3.95	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	868.73	87.34	9.95	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	0.54	6.96	0.08	0.94
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	3.41	1.43	2.38	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	141.16	51.48	2.74	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–124.89	29.94	–4.17	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–0.06	0.79	–0.07	0.94
thinning:initSD.log:yrs.elapsed	0.1	0.1	1	0.32

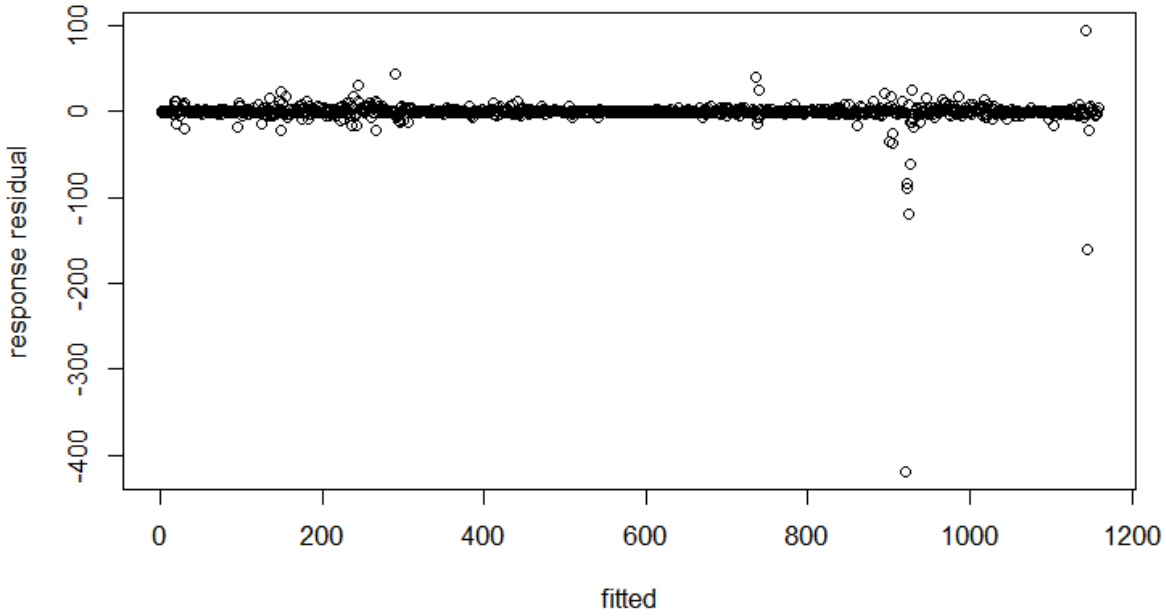

Figure 24 Fitted values and data residuals: sapling abundance

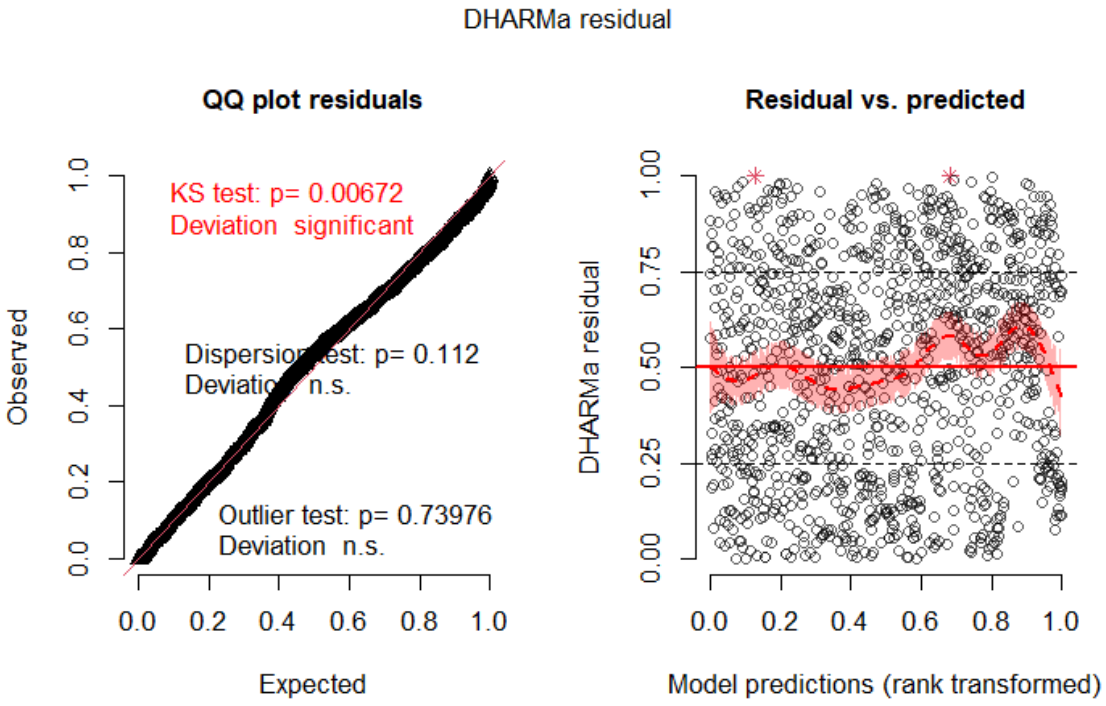

Figure 25 Simulated randomised quantile residuals: sapling abundance

8.3 Seedling abundance

Table 16 Model fitting summary: seedling abundance

Response	Number of seedlings present in each 0.04 ha subplot Positive integer variable

Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Negative binomial, quadratic parameterisation
Outliers removed	None
Reported model formula	4_3_way
Random factors	Year.factor (a factor for each of the 6 survey years) Siteplot (a factor over 66 plots) Subplot (a factor over 198 subplots)
Other transformations compared	None
Other models attempted	Negative Binomial, quadratic parameterisation • 4_way with year factor, site, siteplot and subplot as random effects: Model failed to converge – non-positive definite Hessian matrix • 4_way with year factor, site, and siteplot as random effects: Model failed to converge – non-positive definite Hessian matrix • 3_way with year.factor, site and subplot as random effects: Model converged but failed residual tests • 3_way with yrs.elapsed removed, year.factor as fixed effect and siteplot and subplot as random effects: Model failed to converge – non-positive definite Hessian matrix Poisson: • 4_way with year factor, site, siteplot and subplot as random effects: Model failed to converge – non-positive definite Hessian matrix • 4_way with year factor, site, and siteplot as random effects: Model failed to converge – non-positive definite Hessian matrix • 3_way with year.factor, site and subplot as random effects: Model converged higher AICc when compared to reported model.
Confidence comments	Low to moderate confidence: • Some large residuals for high fitted values • Passed all simulated residual tests • Few (1.8% of 999) failures and fit warnings in bootstrapped simulations • Confidence intervals very narrow for one year

Model summary 13 Seedling abundance

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr...z..
(Intercept)	2.62	1.26	2.09	0.04
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–21.72	43.36	–0.5	0.62
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	6.64	4.6	1.44	0.15
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–2.35	8.79	–0.27	0.79
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	398.58	226.55	1.76	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–1.02	8.58	–0.12	0.91

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	38.29	37.65	1.02	0.31
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	16.31	1304.28	0.01	0.99
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–403.53	121.58	–3.32	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	10.09	4.36	2.31	0.02
site.qualitySQ2	–0.98	0.31	–3.13	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	30.66	7.58	4.05	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	1.56	7.87	0.2	0.84
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–3.03	11.25	–0.27	0.79
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–944.38	308.94	–3.06	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	11.39	10.52	1.08	0.28
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–14.07	4.57	–3.08	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–156.05	159.45	–0.98	0.33
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	637.13	152.22	4.19	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	19.95	4.31	4.63	0
thinning:initSD.log:yrs.elapsed	0.06	0.27	0.21	0.84

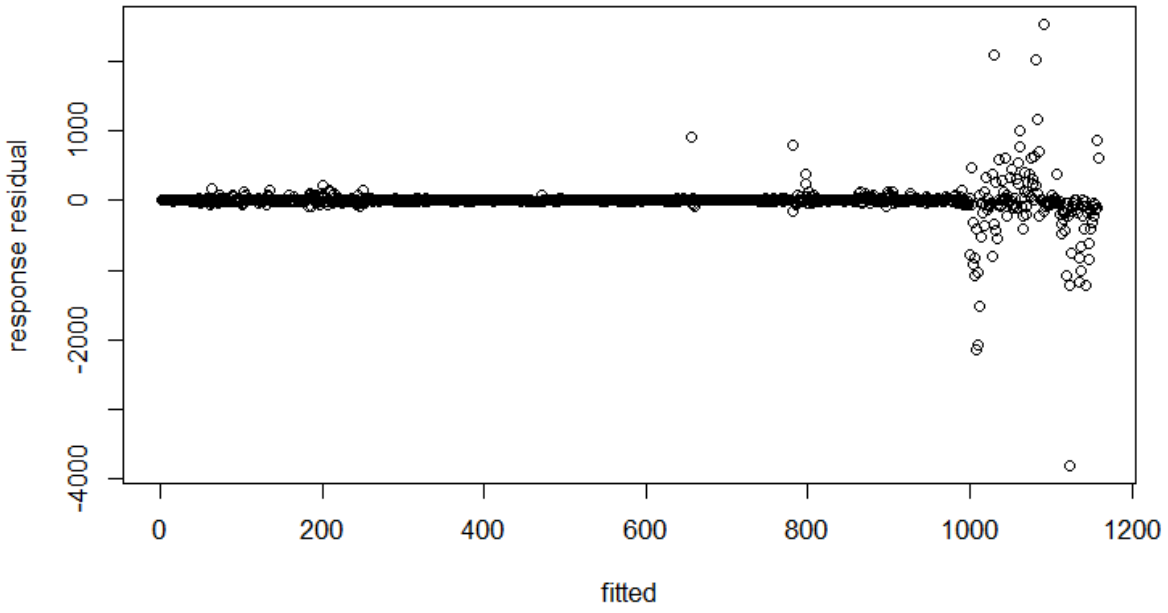

Figure 26 Fitted values and data residuals: seedling abundance

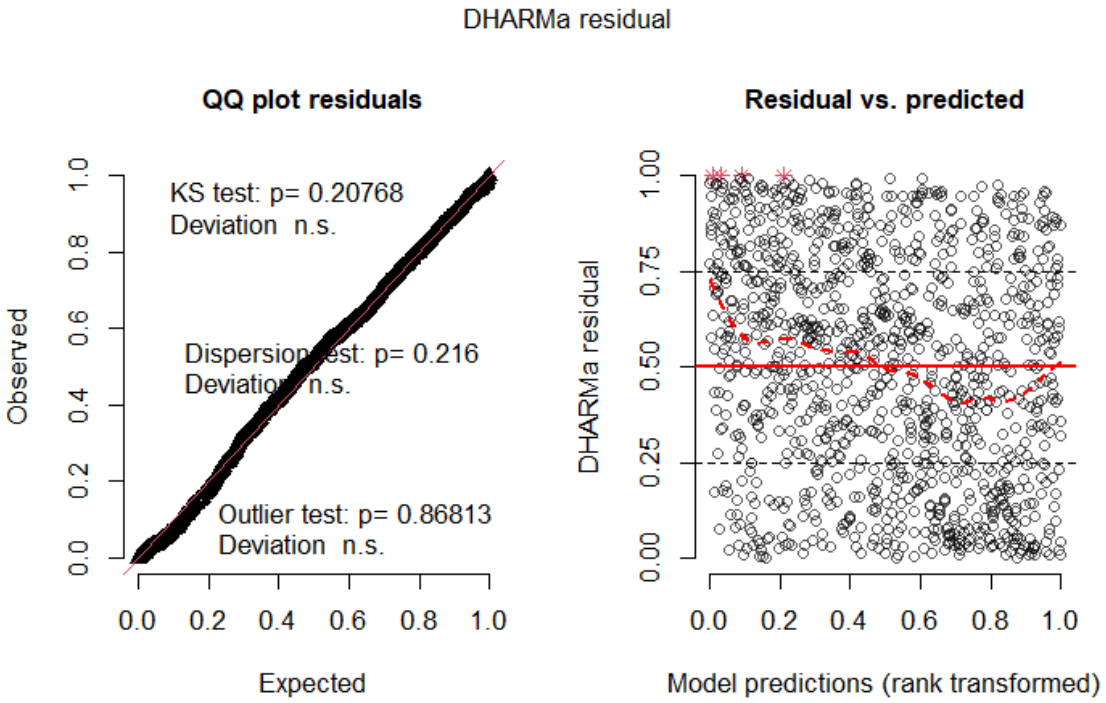

Figure 27 Simulated randomised quantile residuals: seedling abundance

9. Model summaries: Structural diversity

9.1 Heterogeneity in understorey height

Table 17 Model fitting summary: coefficient of variation of understorey height

Response	Coefficient of variation of understorey height in each 0.04 ha subplot Data for 2020–21 and 2021–22 only Positive continuous variable
Response transformations used	None
R package and function	lmer function in lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model	4_way
Random factors	Subplot (a factor over 198 subplots)
Other transformations compared	None
Other models attempted	Gaussian • 4_way: Boundary fit is singular • 4_way with no random effect for site: Boundary fit is singular • 4_way with no random effects for site or plot: Boundary fit is singular • 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but bootstrapped simulations failed • 4_way with no random effect for year factor: No warnings, but bootstrapped simulations failed • 4_way with no random effects for site or year factor: No warnings, but bootstrapped simulations failed • 3_3way: Boundary fit is singular
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (2.8% of 999)

Model summary 14 Coefficient of variation of understorey height

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	0.33	2.93	229.62	0.11	0.91
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–10.42	47.11	229.66	–0.22	0.83

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–0.60	0.36	184.88	–1.68	0.10
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–0.39	3.61	236.11	–0.11	0.91
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–20.26	55.61	245.84	–0.36	0.72
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–0.88	0.46	265.12	–1.90	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–1.26	9.05	229.39	–0.14	0.89
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–38.46	149.75	228.79	–0.26	0.80
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–5.93	11.38	292.01	–0.52	0.60
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–0.26	0.25	199.07	–1.03	0.30
site.qualitySQ2	1.95	3.47	220.25	0.56	0.57
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	33.13	55.67	220.31	0.60	0.55
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	0.49	0.56	166.00	0.89	0.38
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	2.51	4.32	228.31	0.58	0.56
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	69.00	67.38	235.00	1.02	0.31
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	0.09	0.54	229.23	0.17	0.87
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	6.89	10.69	220.78	0.64	0.52
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	102.25	175.20	220.42	0.58	0.56
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	15.14	13.72	268.17	1.10	0.27
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	0.49	0.44	175.77	1.10	0.27
thinning:initSD.log:yrs.elapsed	0.06	0.27	229.76	0.21	0.83
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	–0.19	0.32	220.31	–0.58	0.56

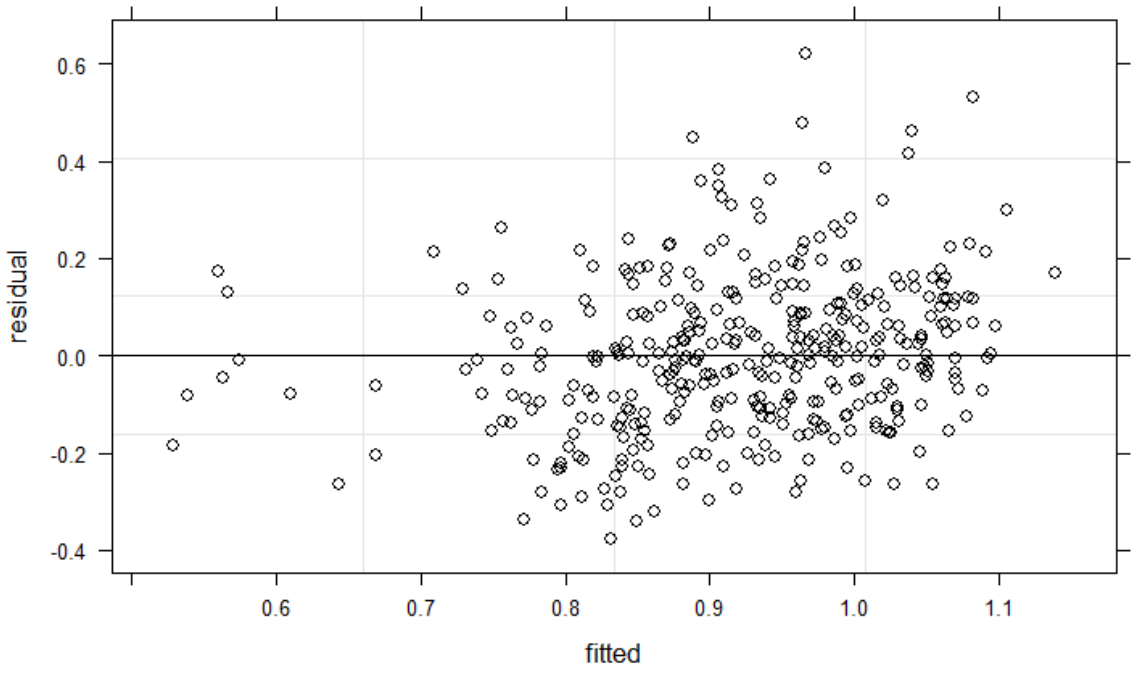

Figure 28 Residuals vs fixed effects: coefficient of variation of understorey height

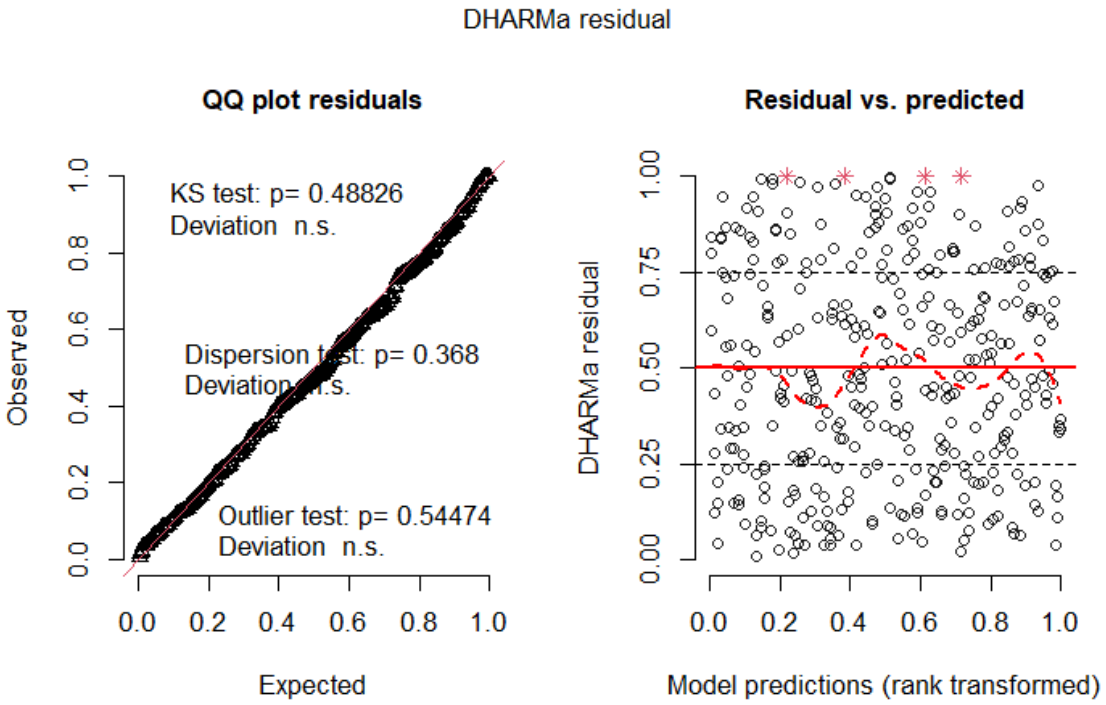

Figure 29 Simulated randomised quantile residuals: coefficient of variation of understorey height

10. Model summaries: Coarse woody debris

10.1 Coarse woody debris volume

Table 18 Model fitting summary: Coarse woody debris volume

Response	Volume (m^3) of coarse woody debris present in each 0.1 ha subplot Positive continuous variable
Response transformation used	None
R package and function	glmmTMB function in glmmTMB package
Distribution used	Gamma, with 'log' link
Outliers removed	None
Model reported	3_3_way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Subplot (a factor over 132 subplots)
Other transformations compared	None
Other models attempted	Gaussian • 4_way: No warnings, but failed residual tests Gamma • 4_way (inverse link): Failed to converge • 4_way (log link): Non-positive definite Hessian • 3_3_way (log link): No warnings, but bootstrapped simulations failed • 3_3_way (log link) with no random effects for site: No warnings, but bootstrapped simulations failed • 4_way (log link) with yrs.elapsed removed and year factor changed from random factor to fixed factor: Non-positive definite Hessian • 4_way_noYrf (log link): Non-positive definite Hessian • 3_3_way_noYrf (log link): No warnings, but bootstrapped simulations failed
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (6% of 999) • Large variance in raw data around model prediction

Model summary 15 Coarse woody debris volume

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	2.63	0.12	21.94	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	0.04	1.05	0.04	0.97

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–0.18	0.78	–0.23	0.82
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	0.84	2.00	0.42	0.67
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	8.38	22.13	0.38	0.71
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	3.23	2.00	1.61	0.11
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–0.33	0.66	–0.51	0.61
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–4.08	12.60	–0.32	0.75
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–10.04	12.06	–0.83	0.40
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–0.26	0.54	–0.47	0.64
site.qualitySQ2	–0.48	0.17	–2.84	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–0.12	1.36	–0.09	0.93
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–0.54	1.32	–0.41	0.68
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–2.46	2.81	–0.87	0.38
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	13.52	30.86	0.44	0.66
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–3.18	2.41	–1.32	0.19
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	0.55	0.90	0.61	0.54
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	8.63	16.94	0.51	0.61
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–0.60	15.93	–0.04	0.97
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–1.09	0.87	–1.25	0.21

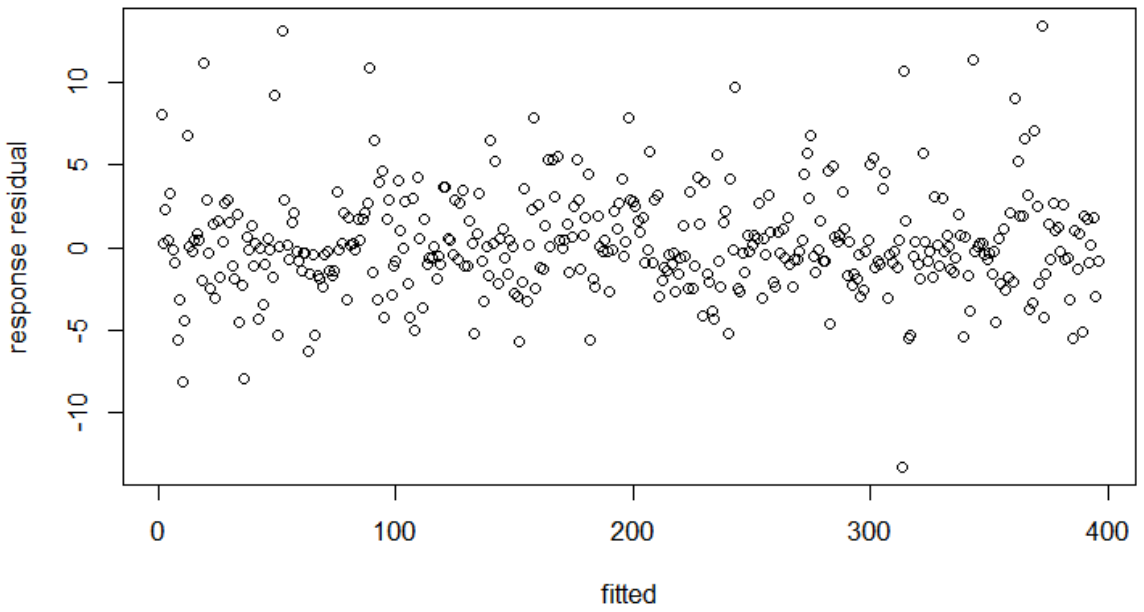

Figure 30 Residuals vs fixed effects: Coarse woody debris volume

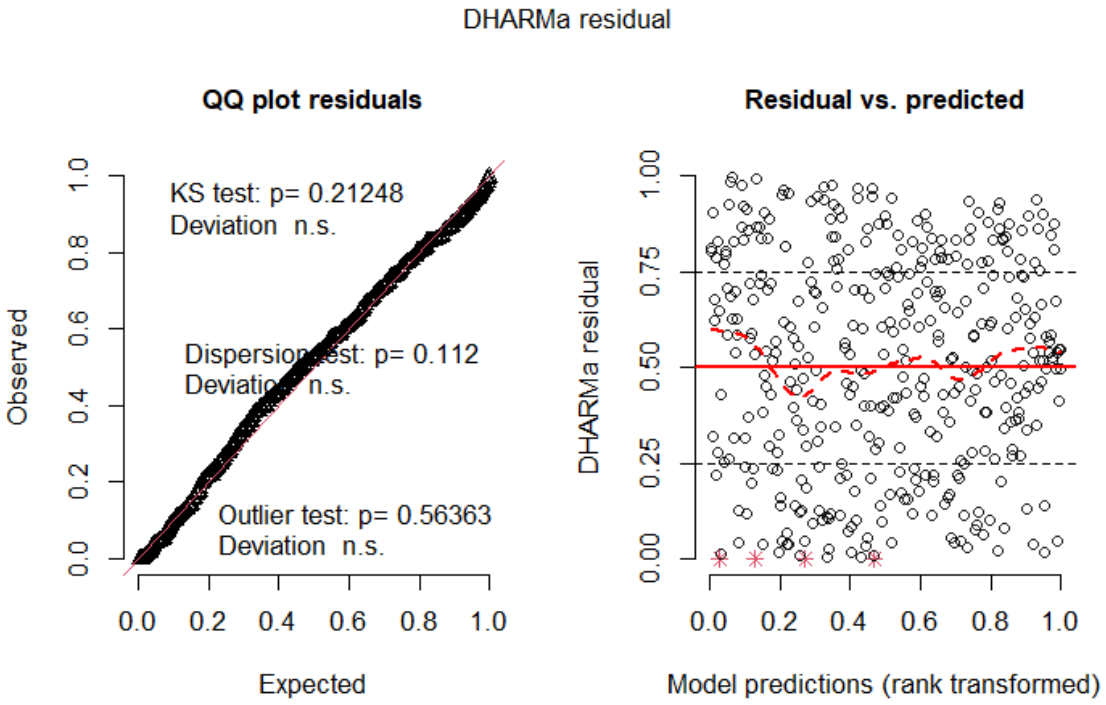

Figure 31 Simulated randomised quantile residuals: Coarse woody debris volume

10.2 Coarse woody debris size heterogeneity

Table 19 Model fitting summary: Coarse woody debris size heterogeneity

Response	Coefficient of variation of diameter of coarse woody debris in each 0.1 ha subplot Positive continuous variable
Response transformation used	None
R package and function	glmmTMB function in glmmTMB package
Distribution used	Gamma, with 'log' link
Outliers removed	None
Model reported	3_3_way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Subplot (a factor over 132 subplots)
Other transformations compared	None
Other models attempted	Gaussian • 4_way: Boundary fit is singular • 3_way: Boundary fit is singular • 3_way with no random effect for year factor: No warnings, but failed residual tests

	• 3_way with no random effect for site factor: No warnings, but failed residual tests Beta • 3_way (converted three values > 1 to 0.99): No warnings, but failed residual tests Gamma • 3_way (log link): No warnings, but bootstrapped simulations failed • 3_way (log link) with no random effect for site factor: No warnings, but bootstrapped simulations failed • 3_way (log link) with yrs.elapsed removed and year factor changed from random factor to fixed factor: Non-positive definite Hessian • 3_3_way_noYrf (log link): Non-positive definite Hessian
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (7% of 999)

Model summary 16 Coarse woody debris size

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	–0.42	0.02	–21.32	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–0.09	0.39	–0.22	0.82
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	0.06	0.30	0.20	0.84
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–0.75	0.42	–1.79	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	0.77	8.59	0.09	0.93
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	0.57	0.43	1.32	0.19
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	0.24	0.27	0.88	0.38
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–3.46	5.57	–0.62	0.53
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–1.34	5.20	–0.26	0.80
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	0.00	0.23	0.01	0.99
site.qualitySQ2	–0.04	0.03	–1.40	0.16
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	0.53	0.51	1.04	0.30
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–0.04	0.49	–0.09	0.93
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	0.65	0.57	1.14	0.26
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	4.49	11.84	0.38	0.70
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–0.61	0.53	–1.14	0.25
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–0.19	0.37	–0.50	0.61
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	0.28	7.46	0.04	0.97
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	1.93	6.88	0.28	0.78
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	0.09	0.37	0.23	0.82

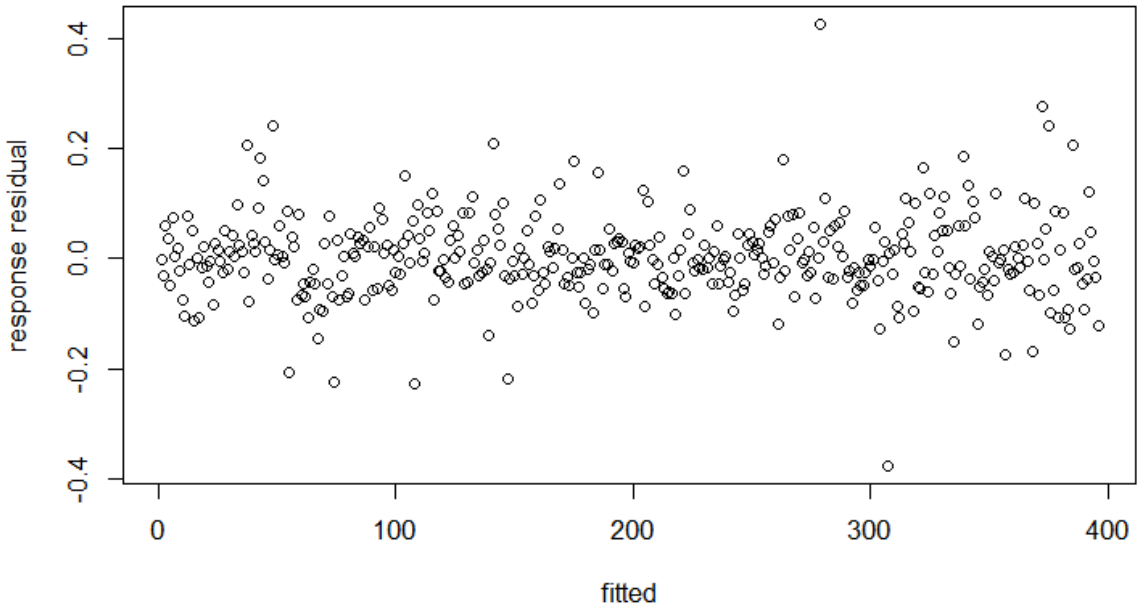

Figure 32 Residuals vs fixed effects: Coarse woody debris size

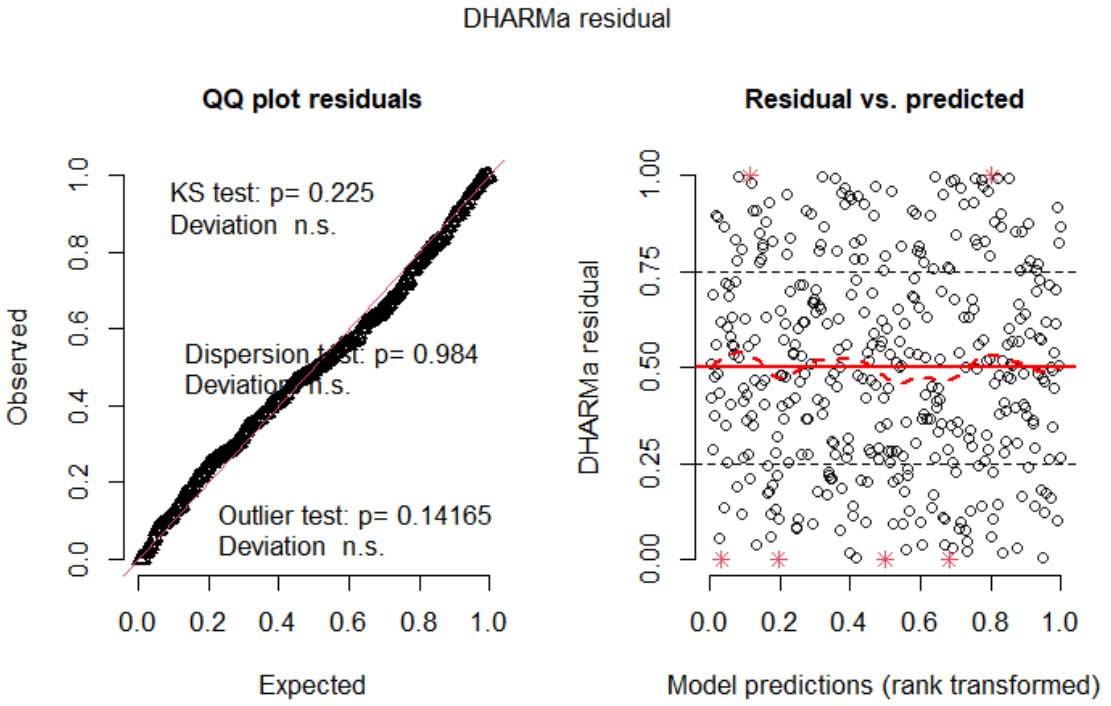

Figure 33 Simulated randomised quantile residuals: Coarse woody debris size

11. Model summaries: Leaf litter heterogeneity

11.1 Heterogeneity in leaf litter cover

Table 20 Model fitting summary: litter cover coefficient of variation

Response	Litter cover was visually estimated in 10 (1 x 1 metre) quadrats in each 0.04-hectare subplot. The coefficient of variation (CV) was calculated across the 10 quadrats for each subplot. Positive continuous variable
Response transformation used	None
R package and function	glmmTMB function in glmmTMB package
Distribution used	Gamma (log link)
Outliers removed	None
Reported model formula	4_3way
Random factors	Subplot (a factor over 198 subplots)
Other transformations compared	None
Other models attempted	Gamma • 4_way: Non-positive definite Hessian • 4_way with no random effects for site: Non-positive definite Hessian • 4_way with no random effects for site, siteplot, or year: Non-positive definite Hessian • 3_3way: No warnings but failed bootstrapped simulations • 3_3way with outlier removed: No warnings but failed bootstrapped simulations • 3_3way with no random effects for site: No warnings but failed bootstrapped simulations • 3_3way with yrs.elapsed removed and year factor changed from random factor to fixed factor: Non-positive definite Hessian • 3_3way with no random effects for year: Non-positive definite Hessian • 3_3way with yrs.elapsed removed and year factor changed from random factor to fixed factor with no random effects for site: Non-positive definite Hessian • 3_3way with yrs.elapsed removed and year factor changed from random factor to fixed factor with no random effects for site or site plot: Non-positive definite Hessian • 3_3way with no random effects for site or year: Non-positive definite Hessian • 3_3way with outlier removed and with no random effects for site or year: No warnings but failed bootstrapped simulations • 3_3way with no random effects for site or siteplot: No warnings but failed some residuals tests. 5% of bootstrapped simulations failed

	• 3_3way with outlier removed and with no random effects for site or siteplot: not considered substantial improvement over above model
Confidence comments	High confidence: • No fit warnings • Conformed to all residual tests • No non-convergence warnings in bootstrapped prediction interval simulations (0% of 999)

Model summary 17 Litter cover coefficient of variation

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	–2.28	0.69	–3.31	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–3.11	24.67	–0.13	0.90
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–0.17	2.26	–0.08	0.94
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–4.85	3.84	–1.26	0.21
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–147.85	121.11	–1.22	0.22
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	2.21	3.50	0.63	0.53
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–12.42	20.62	–0.60	0.55
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–22.15	740.71	–0.03	0.98
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	151.28	62.23	2.43	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–2.97	1.48	–2.01	0.04
site.qualitySQ2	–0.25	0.13	–1.89	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	0.90	3.75	0.24	0.81
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	0.27	3.80	0.07	0.94
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–1.27	4.67	–0.27	0.79
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	137.74	152.82	0.90	0.37
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	1.99	4.29	0.46	0.64
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	2.00	2.33	0.86	0.39
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–151.31	82.61	–1.83	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–198.22	71.75	–2.76	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–1.79	2.13	–0.84	0.40
thinning:initSD.log:yrs.elapsed	0.04	0.15	0.24	0.81

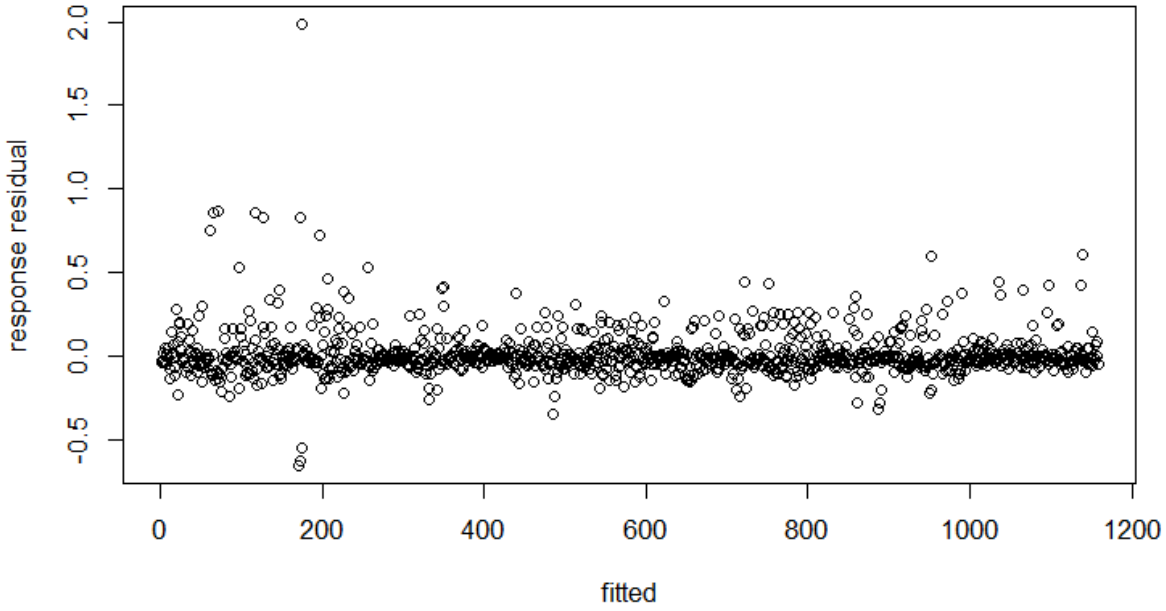

Figure 34 Fitted values and data residuals: litter cover coefficient of variation

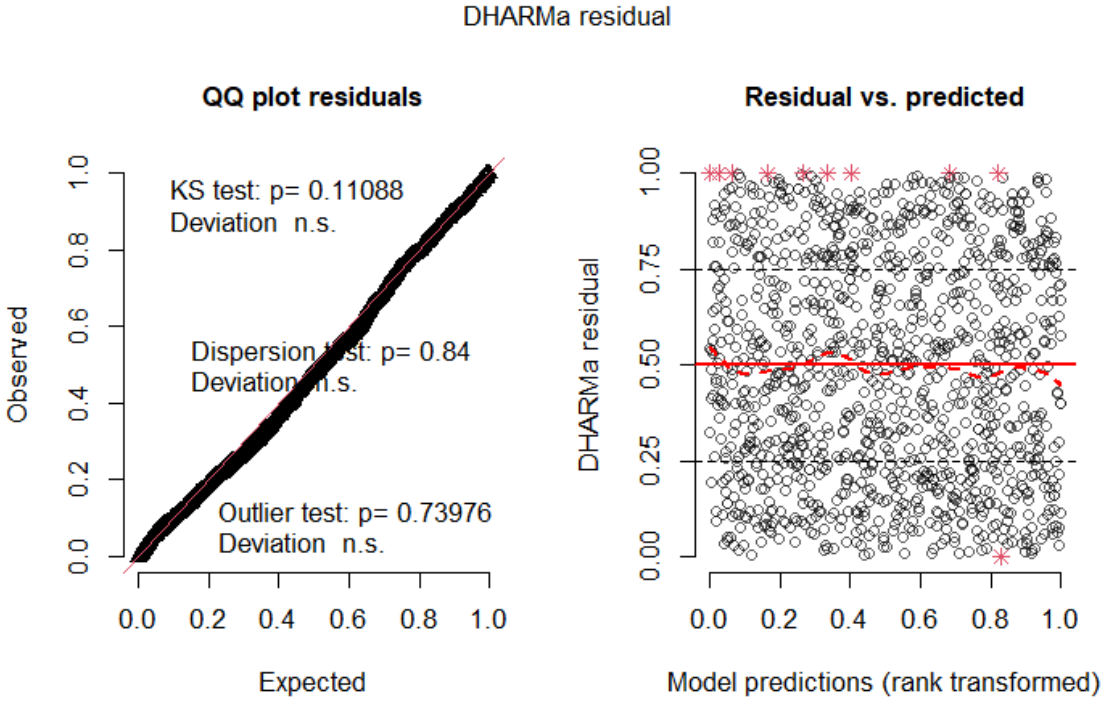

Figure 35 Simulated randomised quantile residuals: litter cover coefficient of variation

11.2 Heterogeneity in leaf litter depth

Table 21 Model fitting summary: litter depth coefficient of variation

Response	Litter depth was measured to the nearest millimetre in 10 (1 x 1 metre) quadrats in each 0.04-hectare subplot. The coefficient of variation (CV) was calculated across the 10 quadrats for each subplot. Positive continuous variable
Response transformation used	None
R package and function	glmmTMB function in glmmTMB package
Distribution used	Gamma (log link)
Outliers removed	1 value that was 2.9
Reported model formula	4_3way
Random factors	Subplot (a factor over 198 subplots) Year.factor (a factor for each of the 6 survey years)
Other transformations compared	None
Other models attempted	Gamma • 4_way: Non-positive definite Hessian • 4_way with no random effects for site, siteplot, or year: Non-positive definite Hessian • 3_3way: No warnings, but failed residual tests and bootstrapped simulations • 3_3way with outlier removed: No warnings, but failed residual tests • 3_3way with yrs.elapsed removed and year factor changed from random factor to fixed factor: Non-positive definite Hessian • 3_3way with no random effects for site: No warnings, but failed residual tests • 3_3way with outlier removed and with no random effects for site: No warnings, but failed residual tests • 3_3way with no random effects for site or siteplot: No warnings, but failed residual tests • 3_3way with no random effects for year: No warnings, but bootstrapped simulations failed • 3_3way with outlier removed and with no random effects for year: No warnings, but bootstrapped simulations failed • 3_3way with no random effects for year or site: No warnings, but bootstrapped simulations failed • 3_3way with outlier removed and with no random effects for year or site: Non-positive definite Hessian • 3_3way with no random effects for year, site, or site: not considered substantial improvement over selected model and didn't have the year factor random effect • 3_3way with outlier removed and with no random effects for year, site, or site: not considered substantial improvement over selected model and didn't have the year factor random effect

Confidence comments	Moderate to high confidence: • No fit warnings • Failed the Kurtosis-Skewness test, with minor deviations from expected • Some non-convergence warnings in bootstrapped prediction interval simulations (5.3% of 999)

Model summary 18 Litter depth coefficient of variation

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	–0.34	0.25	–1.37	0.17
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	9.14	8.83	1.03	0.30
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	0.56	0.83	0.68	0.50
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–0.71	1.26	–0.57	0.57
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–9.18	41.39	–0.22	0.82
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	0.73	1.11	0.66	0.51
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	3.09	7.55	0.41	0.68
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	205.26	266.74	0.77	0.44
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–12.37	22.94	–0.54	0.59
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–0.59	0.88	–0.68	0.50
site.qualitySQ2	–0.07	0.04	–1.68	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–2.26	1.27	–1.78	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–0.21	1.31	–0.16	0.87
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–0.82	1.48	–0.55	0.58
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–22.30	51.78	–0.43	0.67
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–0.89	1.35	–0.66	0.51
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	0.28	0.88	0.32	0.75
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–11.82	31.78	–0.37	0.71
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–8.79	27.43	–0.32	0.75
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–1.39	0.80	–1.73	0.08
thinning:initSD.log:yrs.elapsed	–0.04	0.06	–0.79	0.43

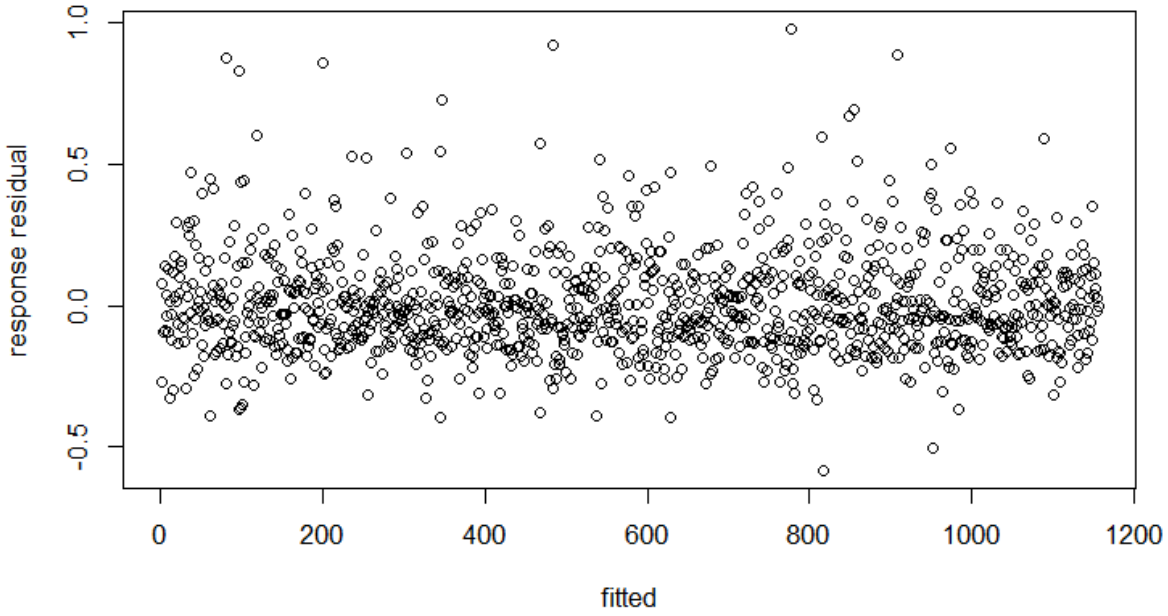

Figure 36 Fitted values and data residuals: litter depth coefficient of variation

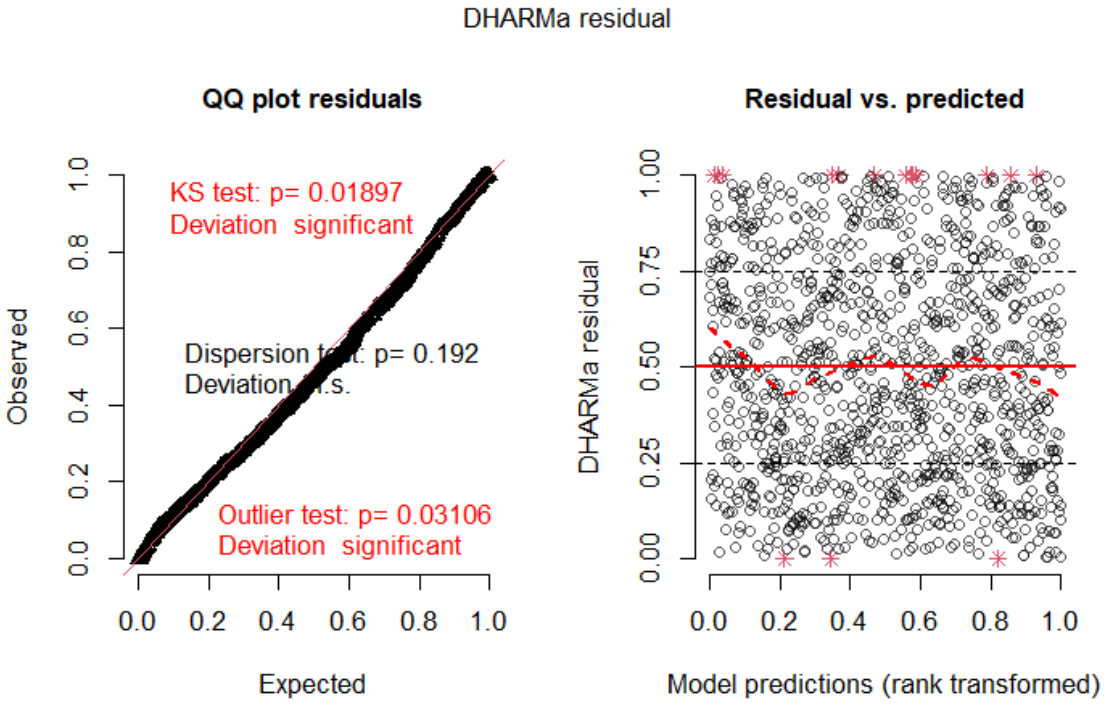

Figure 37 Simulated randomised quantile residuals: litter depth coefficient of variation

12. Standing dead trees

12.1 Count of standing dead trees

Table 22 Model fitting summary: count of standing dead

Response	Number of standing dead trees (stags) per 2-hectare subplot Positive integer variable
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Poisson
Outliers removed	None
Reported model formula	3_3way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 3 survey years)
Other transformations compared	None
Other models attempted	Poisson: • 4_way: Non-positive definite Hessian • 4_way with no random effects for site or year: Non-positive definite Hessian • 3_3way: No warnings but failed bootstrapped simulations Negative Binomial, quadratic parameterisation • 4_way: Non-positive definite Hessian Negative Binomial, linear parameterisation • 4_way: Non-positive definite Hessian
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (7.7% of 999)

Model summary 19 Count of standing dead trees

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	2.46	0.21	11.94	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–0.25	0.88	–0.28	0.78
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	1.85	0.72	2.58	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–1.14	1.40	–0.82	0.41
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–15.00	12.74	–1.18	0.24
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–0.26	1.33	–0.20	0.84

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	1.27	1.95	0.65	0.52
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	4.26	8.45	0.50	0.61
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	5.24	7.95	0.66	0.51
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–1.22	0.75	–1.63	0.10
site.qualitySQ2	–0.41	0.23	–1.77	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	0.86	1.19	0.72	0.47
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–2.89	1.23	–2.35	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	2.25	1.94	1.16	0.25
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	27.68	18.80	1.47	0.14
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–1.79	1.67	–1.08	0.28
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–3.41	0.91	–3.76	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–6.15	12.39	–0.50	0.62
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–20.76	12.32	–1.68	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	1.39	0.92	1.52	0.13

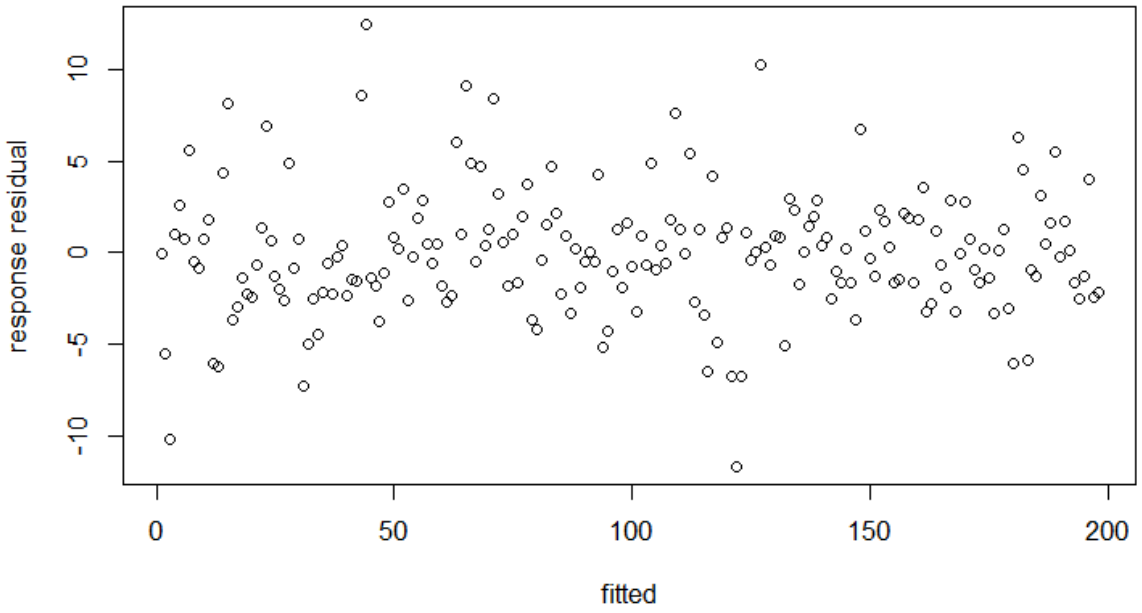

Figure 38 Fitted values and data residuals: count of standing dead trees

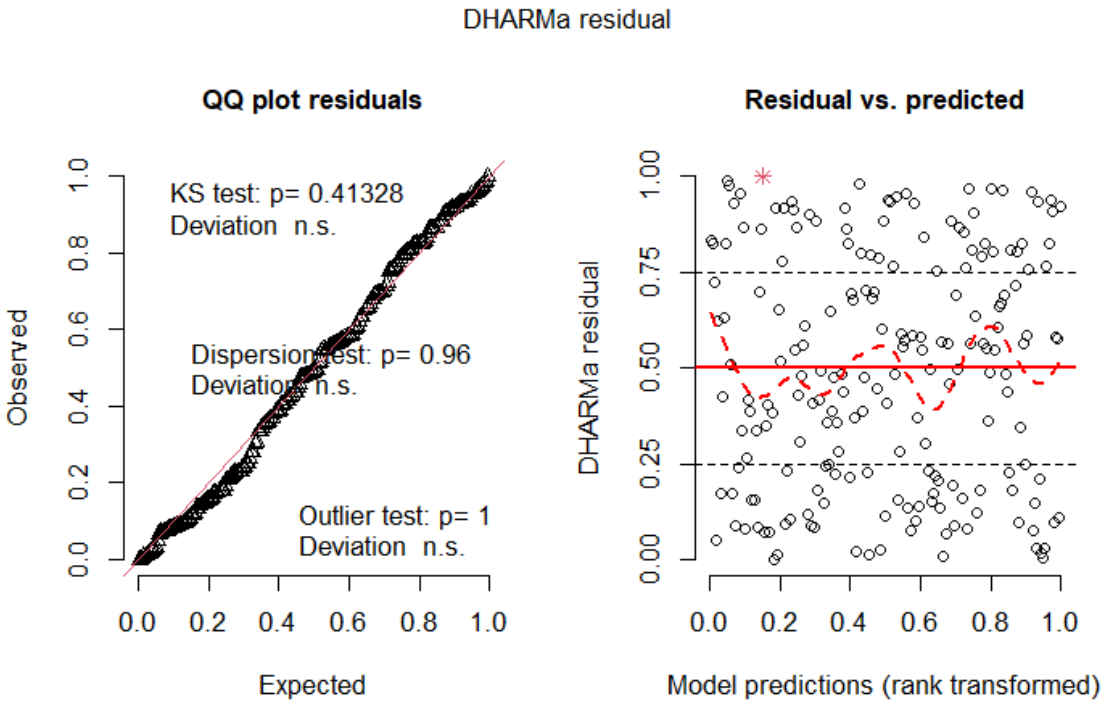

Figure 39 Simulated randomised quantile residuals: count of standing dead trees

13. Model summaries: Fuel hazard

13.1 Overall fuel hazard

Table 23 Model fitting summary: overall fuel hazard

Response	Probability of being in each overall fuel hazard category per 0.04-hectare subplot Categorical variable
Response transformation used	None
R package and function	brm function from brms package with family specified as cratio(threshold = flexible)
Distribution used	Continuation ratio with flexible category thresholds The cumulative model has an underlying distribution that spans all categories, which is appropriate for fuel hazard because hazard is an underlying continuous variable and responses can move up and down as well as jump categories. (In contrast, an adjacent categories model assumes each level of risk rating has its own distribution, and sequential models assume response data can only move sequentially through the levels.) Flexible thresholds allow for the boundaries between hazard rating categories to have unequal sizes and account for different proportions of the data. This is supported by the input data where more sites report moderate or high ratings than low or very high ratings.
Outliers removed	None
Model reported	4_way, with iterations = 2000, chains = 4, warmup = 500, max tree depth = 15, priors for all betas = normal(0,10)
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Subplot (a factor over 198 subplots) Year.factor (a factor for each of the 5 survey years)
Other transformations compared	None
Other models attempted	None
Confidence comments	High confidence • No fit warnings or failures to converge • Chains mixed well

Model summary 20 Overall fuel hazard

	Estimate	Est. Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Intercept[1]	–4.42	0.60	–5.58	–3.24	1.00	2547.26	2715.21
Intercept[2]	–0.69	0.57	–1.76	0.46	1.00	2268.27	2500.36
Intercept[3]	8.37	0.97	6.61	10.48	1.00	3996.86	4394.38
polycbindthinninginitSD.logyrs.elapsed 21.0.0	–1.29	6.45	–13.77	11.35	1.00	6765.71	4914.01
polycbindthinninginitSD.logyrs.elapsed 22.0.0	–0.37	5.10	–10.53	9.62	1.00	6129.63	4817.79

polycbindthinninginitSD.logyrs.elapsed 20.1.0	1.60	5.97	–10.12	13.22	1.00	5719.90	4196.10
polycbindthinninginitSD.logyrs.elapsed 21.1.0	0.33	9.90	–18.94	19.67	1.00	11520.67	4272.81
polycbindthinninginitSD.logyrs.elapsed 20.2.0	–1.12	5.91	–12.55	10.46	1.00	5116.33	4688.90
polycbindthinninginitSD.logyrs.elapsed 20.0.1	2.08	8.31	–15.54	17.54	1.00	5608.78	4235.29
polycbindthinninginitSD.logyrs.elapsed 21.0.1	0.00	10.07	–19.82	19.72	1.00	13574.50	3708.54
polycbindthinninginitSD.logyrs.elapsed 20.1.1	–1.03	9.98	–20.52	18.27	1.00	12540.98	3995.50
polycbindthinninginitSD.logyrs.elapsed 20.0.2	0.48	5.23	–9.74	10.72	1.00	8114.38	4197.55
site.qualitySQ2	–0.05	0.44	–0.92	0.84	1.00	4196.37	4214.96
polycbindthinninginitSD.logyrs.elapsed 21.0.0:site.qualitySQ2	–14.16	7.12	–28.27	0.09	1.00	7312.65	5154.69
polycbindthinninginitSD.logyrs.elapsed 22.0.0:site.qualitySQ2	8.51	6.48	–4.14	21.45	1.00	7591.53	4711.83
polycbindthinninginitSD.logyrs.elapsed 20.1.0:site.qualitySQ2	1.25	7.22	–12.75	15.54	1.00	5670.90	4724.04
polycbindthinninginitSD.logyrs.elapsed 21.1.0:site.qualitySQ2	0.59	10.15	–18.66	20.53	1.00	13726.81	4435.72
polycbindthinninginitSD.logyrs.elapsed 20.2.0:site.qualitySQ2	–4.35	6.84	–17.92	9.08	1.00	5751.97	4969.68
polycbindthinninginitSD.logyrs.elapsed 20.0.1:site.qualitySQ2	–0.90	5.71	–11.87	10.60	1.00	6053.91	4635.13
polycbindthinninginitSD.logyrs.elapsed 21.0.1:site.qualitySQ2	0.43	10.25	–19.20	20.37	1.00	12448.49	4446.64
polycbindthinninginitSD.logyrs.elapsed 20.1.1:site.qualitySQ2	–0.31	9.93	–19.36	18.59	1.00	12460.46	4189.38
polycbindthinninginitSD.logyrs.elapsed 20.0.2:site.qualitySQ2	2.49	4.65	–6.58	11.70	1.00	10062.99	5148.86
thinning:initSD.log:yrs.elapsed	0.02	0.03	–0.05	0.08	1.00	5137.78	4826.21
site.qualitySQ2:thinning:initSD.log:yrs. elapsed	0.04	0.04	–0.04	0.12	1.00	4686.17	4408.94

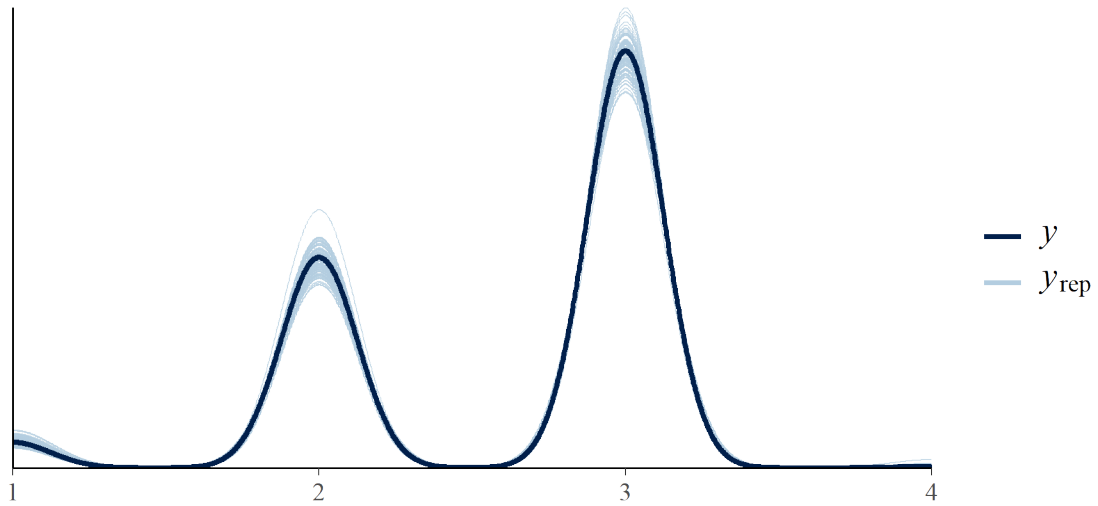

Figure 40 Observed data (y) and 100 draws from the model posterior distribution (yrep) for overall fuel hazard

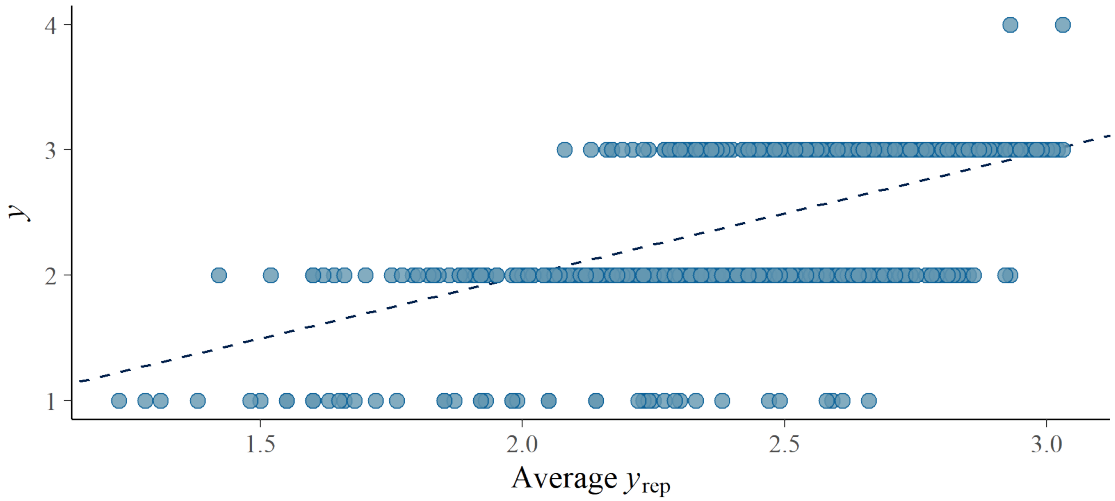

Figure 41 Surface fuel hazard posterior average scatter plot

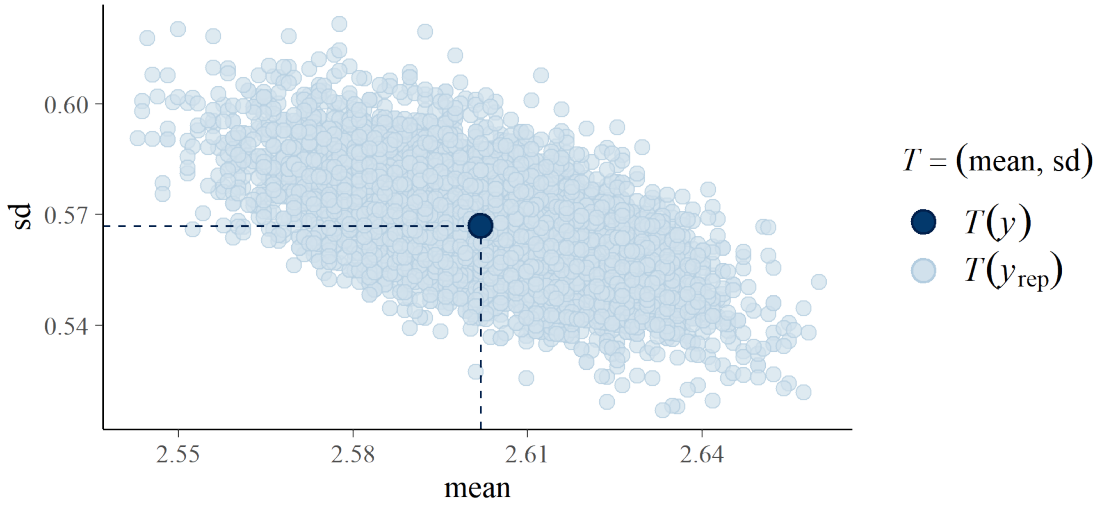

Figure 42 Surface fuel hazard posterior mean and standard deviation

13.2 Surface fuel hazard: litter depth

Table 24 Model fitting summary: litter depth

Response	Litter depth, measured in 10 quadrats in each 0.04-hectare subplot, in millimetres. Averaged for each subplot. Positive continuous variable
Response transformation used	Log transformed
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model formula	3_3way

Random factors	Siteplot (a factor over 66 plots) Subplot (a factor over 198 subplots) Year.factor (a factor for each of the 6 survey years)
Other transformations compared	Untransformed data attempted (see below for models this was tried with)
Other models attempted	Models attempted without averaging across each subplot (and included a random factor for quadrat unless otherwise specified) • 4_way (Gaussian, log transformed variable): Failed to converge • 3_3way (Gaussian, log transformed variable) with no random effects for year factor, site, or quadrat: No warnings, but failed residual tests • 3_3way (Gamma, untransformed variable – changed zeroes to small value) with no random effects for site or quadrat: No warnings, but failed residual tests • 4_way (Zero Inflated Gamma, untransformed variable): Non-positive definite Hessian Other models attempted on averaged data • 4_way (Gaussian, untransformed variable): No warnings, but failed residual tests • 4_way_noYrf (Gaussian, untransformed variable): No warnings, but failed residual tests • 4_way (Gaussian, untransformed variable) with no random effects for site: No warnings, but failed residual tests • 4_way (Gaussian, untransformed variable) with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but failed residual tests • 3_3way (Gaussian, untransformed variable): No warnings, but failed residual tests • 3_3way (Gaussian, untransformed variable) with no random effects for site: No warnings, but failed residual tests • 3_3way (Gaussian, untransformed variable) with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but failed residual tests • 3_3way_noYrf (Gaussian, untransformed variable): No warnings, but failed residual tests • 4_way (Gamma, untransformed variable – changed zeroes to small value): Non-positive definite Hessian • 3_3way (Gamma, untransformed variable – changed zeroes to small value): No warnings, but failed residual tests • 3_3way (Gamma, untransformed variable – changed zeroes to small value) with no random effects for site: No warnings, but failed residual tests • 3_3way_noYrf (Gamma, untransformed variable – changed zeroes to small value): Failed to converge • 3_3way (Gamma, untransformed variable – changed zeroes to small value) with yrs.elapsed removed and year factor changed from random factor to fixed factor: Failed to converge • 4_way (Gaussian, log transformed variable): Boundary fit is singular • 3_3way (Gaussian, log transformed variable): Boundary fit is singular • 3_3way (Gaussian, log transformed variable) with no random effect for site factor: No warnings, but bootstrapped simulations failed • 3_3way (Gaussian, log transformed variable) with no random effects for site or plot: No warnings, but bootstrapped simulations failed

	• 3_3way_noYrf (Gaussian, log transformed variable): No warnings, but bootstrapped simulations failed • 3_3way (Gaussian, log transformed variable) with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but bootstrapped simulations failed
Confidence comments	Moderate confidence: • No fit warnings • Failed the Kurtosis-Skewness test, with minor deviations from expected • ~9% boundary singular fit warnings, < 5% non-convergence warnings in bootstrapped prediction interval simulations (out of 999) • Apparent pattern with larger residuals at larger thinning intensities

Model summary 21 Litter depth

	Estimate	Std. Error	Df	t value	Pr(>|t|)
(Intercept)	2.93	0.07	8.85	41.50	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	0.58	1.24	485.25	0.47	0.64
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–0.94	1.01	496.72	–0.94	0.35
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–1.68	1.74	63.61	–0.96	0.34
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–69.77	45.18	672.81	–1.54	0.12
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	1.49	1.82	62.29	0.82	0.42
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–1.53	1.81	5.01	–0.84	0.44
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	6.51	24.82	813.13	0.26	0.79
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	9.90	22.49	996.01	0.44	0.66
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–0.52	0.81	189.46	–0.64	0.52
site.qualitySQ2	–0.02	0.07	64.44	–0.34	0.74
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–1.36	1.54	523.13	–0.88	0.38
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	0.89	1.61	512.55	0.55	0.58
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	3.05	2.37	69.44	1.29	0.20
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	134.77	61.59	616.83	2.19	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–2.09	2.23	61.44	–0.94	0.35
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–0.22	0.91	1001.18	–0.24	0.81
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	25.53	30.45	965.30	0.84	0.40
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–35.73	28.62	1002.56	–1.25	0.21
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	0.60	0.81	1003.98	0.74	0.46

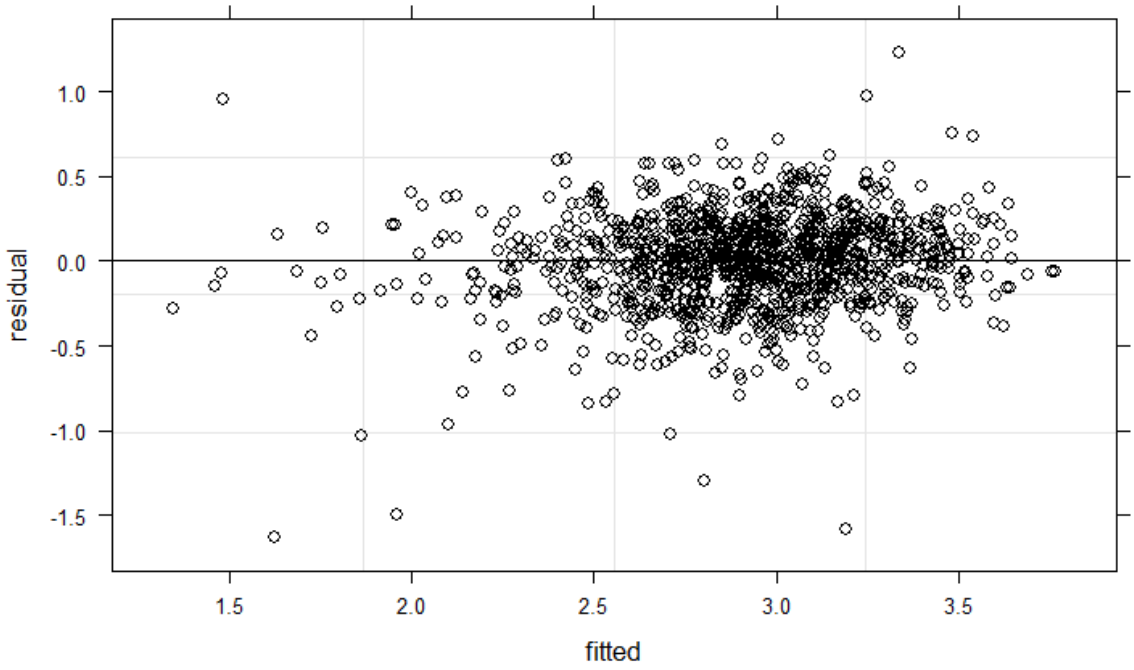

Figure 43 Fitted values and data residuals: litter depth

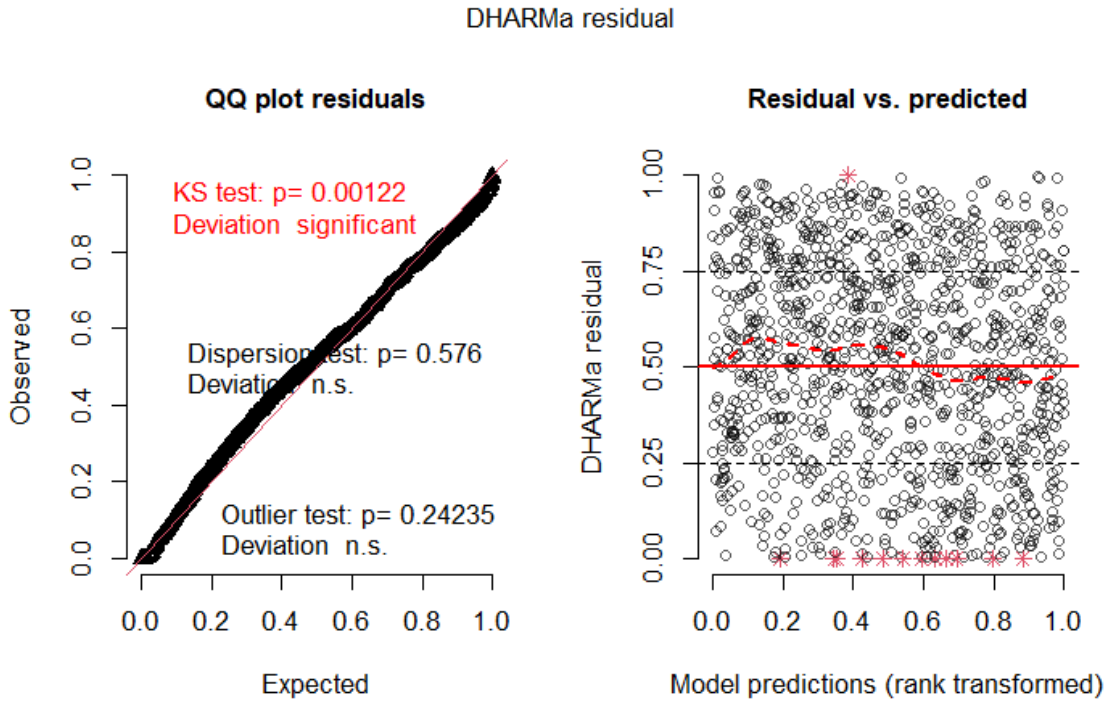

Figure 44 Simulated randomised quantile residuals: litter depth

13.3 Surface fuel hazard: litter cover

Table 25 Model fitting summary: litter cover

Response	Litter cover is visually estimated as a percentage of three 0.04 ha plots per 9-hectare plot Positive continuous bounded (proportion) variable
Response transformation used	We calculated the percentage of each subplot that was not litter cover, by subtracting litter cover percentage from 100, so we could fit a Gamma model
R package and function	glmmTMB function of glmmTMB package
Distribution used	Zero Inflated Gamma
Outliers removed	None (though see 'Other models attempted')
Reported model formula	4_3way
Random factors	Subplot (a factor over 198 subplots)
Other transformations compared	Original data as a proportion (changed zeroes to small value so Beta model could be fit)
Other models attempted	• 4_way (Beta): Non-positive definite Hessian • 4_way (Beta) with no random effects for year or site: Non-positive definite Hessian • 3_3way (Beta): Non-positive definite Hessian • 3_3way (Beta) with no random effects for year: Non-positive definite Hessian • 3_3way (Beta) with no random effects for site: No warnings, but failed residual tests • 3_3way (Beta) with no random effects for year or site: No warnings, but failed residual tests Models attempted after removing values less than 25% • 4_way (Beta): Non-positive definite Hessian • 4_way (Beta) with no random effects for year or site: Non-positive definite Hessian • 3_3way (Beta): No warnings, but failed residual tests Models attempted on inverse of variable (percentage of subplots that weren't litter cover) • 4_way (Zero Inflated Gamma): Non-positive definite Hessian • 4_way (Zero Inflated Gamma) with no random effects for site: Non-positive definite Hessian • 4_way (Zero Inflated Gamma) with no random effects for year: Non-positive definite Hessian • 4_way (Zero Inflated Gamma) with no random effects for year or site: Non-positive definite Hessian • 3_3way (Zero Inflated Gamma): No warnings, but bootstrapped simulations failed • 3_3way (Zero Inflated Gamma) with no random effects for site: No warnings, but bootstrapped simulations failed • 3_3way (Zero Inflated Gamma) with no random effects for year: No warnings, but bootstrapped simulations failed • 3_3way (Zero Inflated Gamma) with no random effects for year or site: No warnings, but bootstrapped simulations failed

	• 3_3way (Zero Inflated Gamma) with yrs.elapsed removed and year factor changed from random factor to fixed factor: Non-positive definite Hessian
Confidence comments	Low to moderate confidence: • Difficulty fitting a model • No fit warnings for reported model • Failed the Kurtosis-Skewness test, with minor deviations from expected • Some non-convergence warnings in bootstrapped prediction interval simulations (79 out of 999) • Variance was highest at the plot level, likely causing model convergence issues when included in the model

Model summary 22 Litter cover

	Estimate	Std.Error	z.value	Pr..z.
(Intercept)	0.006098	0.616275	0.009894	0.992106
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–82.2544	21.61852	–3.80481	0.000142
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	0.171991	2.022925	0.085021	0.932245
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–9.99425	3.277459	–3.04939	0.002293
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–167.207	103.4191	–1.61679	0.105924
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	4.038278	2.917411	1.384199	0.166297
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–81.9792	17.82257	–4.59974	4.23E-06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–2261.96	627.2618	–3.60608	0.000311
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	31.0561	55.44743	0.5601	0.575411
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–4.69178	1.370318	–3.42386	0.000617
site.qualitySQ2	–0.46466	0.111869	–4.1536	3.27E-05
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	5.732653	3.275918	1.749938	0.080129
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	0.247037	3.420713	0.072218	0.942428
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–6.57585	4.000951	–1.64357	0.100265
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–100.345	131.7333	–0.76173	0.446221
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–4.77916	3.581394	–1.33444	0.18206
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–4.65035	2.100231	–2.21421	0.026815
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–65.3197	73.50064	–0.8887	0.374167
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–178.835	64.28005	–2.78213	0.0054
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	4.777804	1.994254	2.395786	0.016585
thinning:initSD.log:yrs.elapsed	0.506402	0.133821	3.784178	0.000154

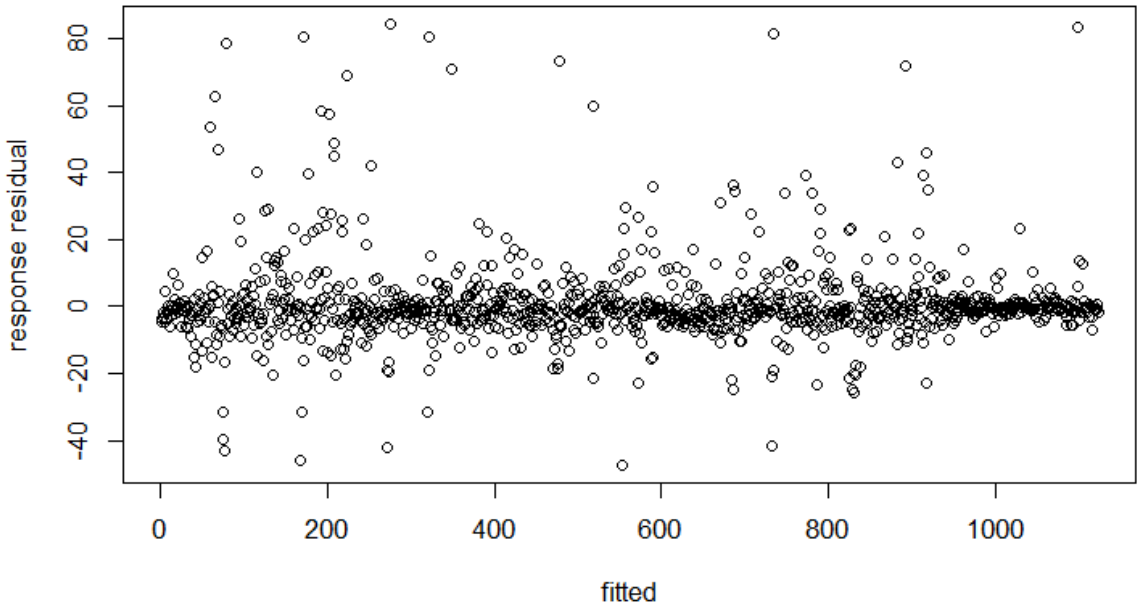

Figure 45 Fitted values and data residuals: litter cover

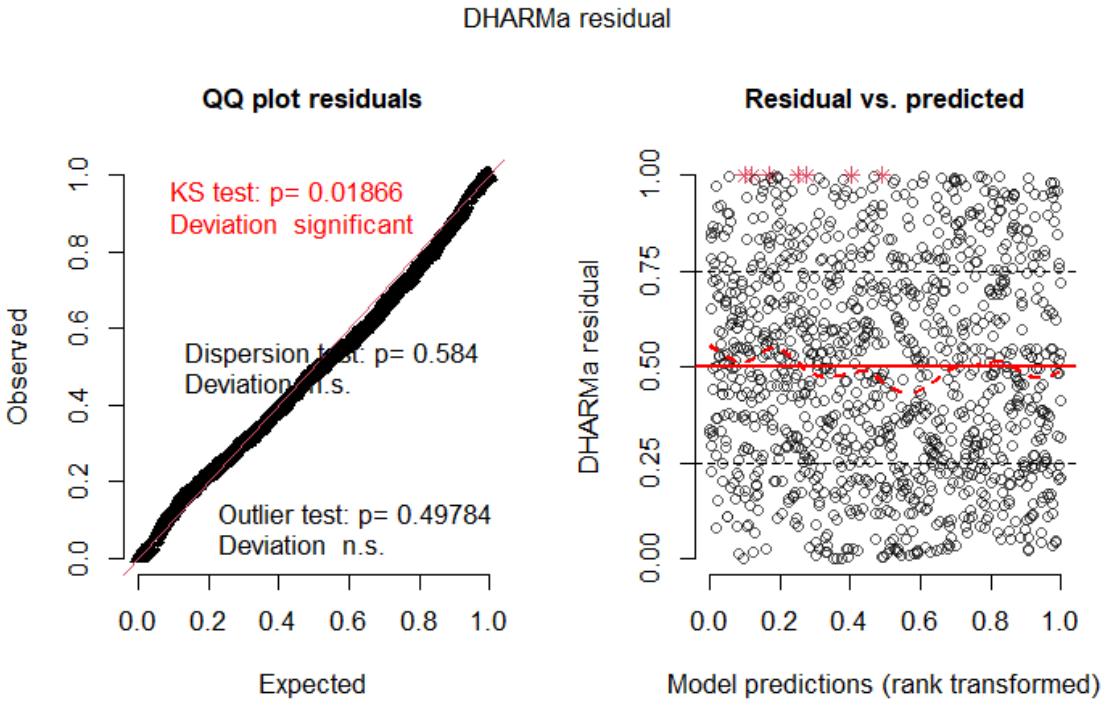

Figure 46 Simulated randomised quantile residuals: litter cover

13.4 Surface fuel hazard assessment

Table 26 Model fitting summary: surface fuel hazard

Response	Probability of being in each surface fuel hazard category per 0.04-hectare subplot Categorical variable
Response transformation used	None
R package and function	brm function from brms package with family specified as cratio(threshold = flexible)
Distribution used	Continuation ratio with flexible category thresholds The cumulative model has an underlying distribution that spans all categories, which is appropriate for fuel hazard because hazard is an underlying continuous variable and responses can move up and down as well as jump categories. (In contrast, an adjacent categories model assumes each level of risk rating has its own distribution, and sequential models assume response data can only move sequentially through the levels.) Flexible thresholds allow for the boundaries between hazard rating categories to have unequal sizes and account for different proportions of the data. This is supported by the input data where more sites report moderate or high ratings than low or very high ratings.
Outliers removed	None
Model reported	4_way, with iterations = 2000, chains = 4, warmup = 500, max tree depth = 15, priors for all betas = normal(0,10)
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Subplot (a factor over 198 subplots) Year.factor (a factor for each of the 5 survey years)
Other transformations compared	None
Other models attempted	None
Confidence comments	High confidence • No fit warnings or failures to converge • Chains mixed well

Model summary 23 Surface fuel hazard

	Estimate	Est. Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Intercept[1]	–4.31	0.53	–5.39	–3.31	1.00	2259.27	2863.14
Intercept[2]	–1.38	0.50	–2.41	–0.42	1.00	2071.22	2873.20
Intercept[3]	1.84	0.51	0.84	2.84	1.00	2088.85	3044.11
Intercept[4]	5.60	0.59	4.44	6.77	1.00	2725.79	3726.23
polycbindthinninginitSD.logyrs.elapsed21.0.0	–0.17	5.86	–11.62	11.33	1.00	5362.76	4868.28
polycbindthinninginitSD.logyrs.elapsed22.0.0	–5.15	4.75	–14.29	3.88	1.00	4893.06	4814.67
polycbindthinninginitSD.logyrs.elapsed20.1.0	5.63	5.95	–6.14	17.32	1.00	4417.59	4165.92
polycbindthinninginitSD.logyrs.elapsed21.1.0	0.21	9.96	–19.55	19.79	1.00	17042.42	4197.98
polycbindthinninginitSD.logyrs.elapsed20.2.0	–1.62	6.06	–13.65	9.94	1.00	4058.53	4275.16
polycbindthinninginitSD.logyrs.elapsed20.0.1	5.15	8.31	–12.04	20.82	1.00	4919.56	4681.43
polycbindthinninginitSD.logyrs.elapsed21.0.1	–0.11	10.57	–20.68	20.23	1.00	14440.56	4407.57
polycbindthinninginitSD.logyrs.elapsed20.1.1	0.23	9.79	–19.06	19.41	1.00	13266.01	4562.83

polycbindthinninginitSD.logyrs.elapsed20.0.2	6.90	4.38	–1.47	15.65	1.00	6960.87	4486.96
site.qualitySQ2	0.08	0.46	–0.86	1.02	1.00	2963.69	3554.34
polycbindthinninginitSD.logyrs.elapsed21.0.0:site.qualitySQ2	–10.54	6.75	–23.52	2.62	1.00	5706.08	4780.42
polycbindthinninginitSD.logyrs.elapsed22.0.0:site.qualitySQ2	7.20	5.88	–4.45	18.76	1.00	6332.27	4986.76
polycbindthinninginitSD.logyrs.elapsed20.1.0:site.qualitySQ2	0.41	7.45	–13.76	15.23	1.00	4991.08	4720.72
polycbindthinninginitSD.logyrs.elapsed21.1.0:site.qualitySQ2	0.92	10.00	–18.86	20.37	1.00	16516.98	3433.11
polycbindthinninginitSD.logyrs.elapsed20.2.0:site.qualitySQ2	–1.48	7.06	–15.25	12.19	1.00	4986.46	4753.05
polycbindthinninginitSD.logyrs.elapsed20.0.1:site.qualitySQ2	2.15	5.03	–7.78	11.82	1.00	6043.04	4729.64
polycbindthinninginitSD.logyrs.elapsed21.0.1:site.qualitySQ2	0.22	9.94	–19.09	19.54	1.00	14943.29	3906.32
polycbindthinninginitSD.logyrs.elapsed20.1.1:site.qualitySQ2	0.90	10.10	–18.58	20.59	1.00	11421.45	4312.92
polycbindthinninginitSD.logyrs.elapsed20.0.2:site.qualitySQ2	0.21	3.89	–7.53	7.81	1.00	8022.98	4792.96
thinning:initSD.log:yrs.elapsed	–0.01	0.03	–0.06	0.05	1.00	5558.99	5037.69
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	0.03	0.03	–0.03	0.10	1.00	4806.74	4834.27

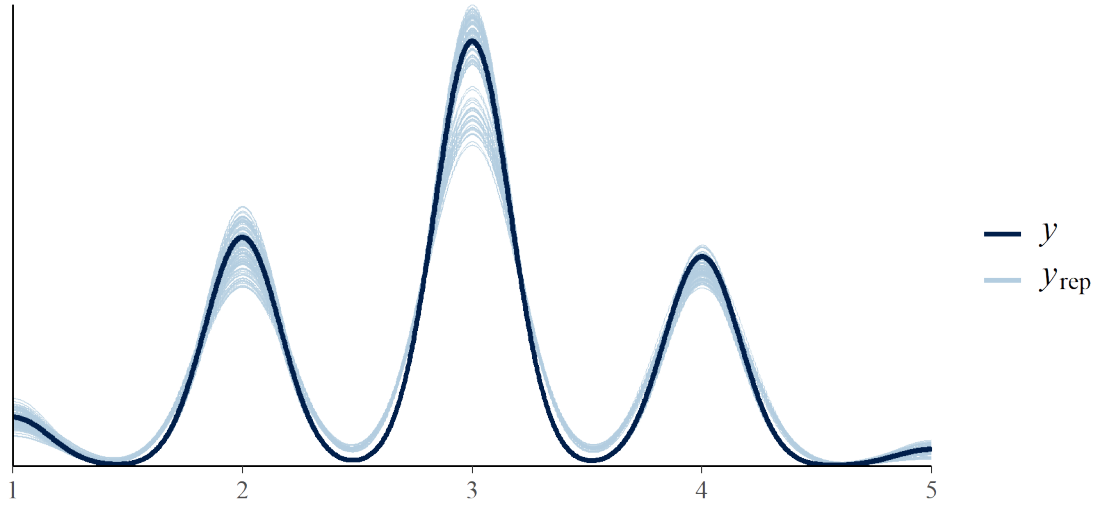

Figure 47 Observed data (y) and 100 draws from the model posterior distribution (yrep) for surface fuel hazard

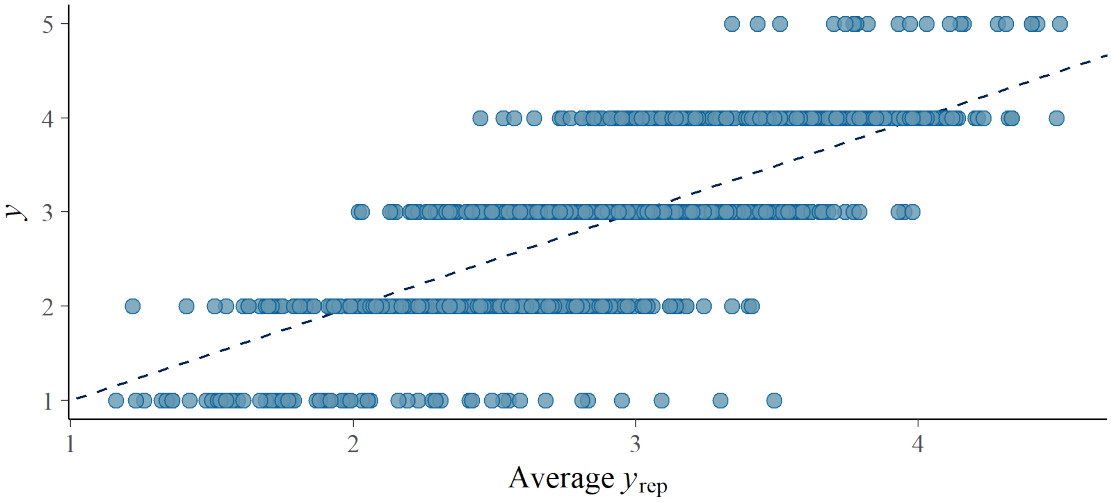

Figure 48 Surface fuel hazard posterior average scatter plot

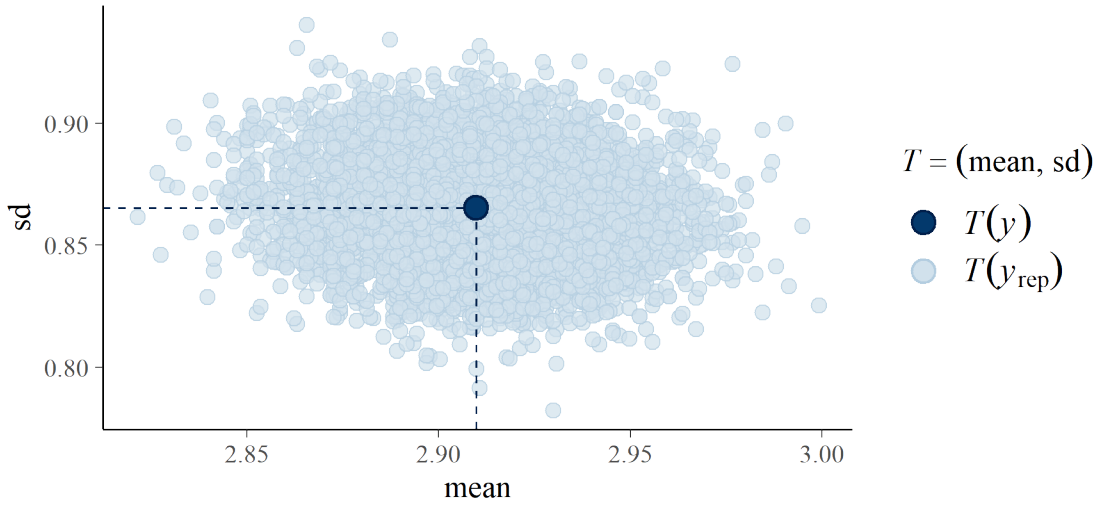

Figure 49 Surface fuel hazard posterior mean and standard deviation

13.5 Near surface fuel hazard: live near surface vegetation

Table 27 Model fitting summary: live near surface vegetation cover

Response	Visual estimates of live near surface vegetation cover (%) per 0.04-hectare plot Positive continuous bounded (proportion) variable
Response transformation used	One value of zero was increased to 0.001
R package and function	glmmTMB
Distribution used	Gamma distribution with a log link
Outliers removed	None
Model reported	4_3way
Random factors	9-hectare plot Subplot
Other transformations compared	None
Other models attempted	Binomial • 4_way: Failed to converge • 3_3_way with no year.factor, site or siteplot: Failed all residual tests Beta • 4_way: Failed to converge • 3_3_way with no year.factor, site or siteplot: Failed to converge Gamma • 4_way (log link): Failed to converge • 3_way (log link) with either no year.factor and/or no site: Failed to converge

	• 3_way_no yrs.elapsed but year.factor as a fixed effect: Failed to converge
Confidence comments	Moderate confidence: • No fit warning • Failed Kurtosis-Skewness test with minor deviation from expectation • 7.4% failure to converge in bootstrapped simulations

Model summary 24 Live near surface vegetation cover

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr...z..
(Intercept)	–4.09	0.74	–5.52	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–60.57	26.46	–2.29	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–1.99	2.49	–0.80	0.42
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–4.30	3.78	–1.14	0.26
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–46.46	130.65	–0.36	0.72
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	6.26	3.38	1.85	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–56.92	22.22	–2.56	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–1398.51	795.41	–1.76	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	122.21	76.52	1.60	0.11
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	0.17	1.87	0.09	0.93
site.qualitySQ2	–0.41	0.13	–3.26	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	10.52	4.01	2.62	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–2.19	4.20	–0.52	0.60
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	1.81	4.55	0.40	0.69
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–1.98	167.21	–0.01	0.99
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–3.42	4.14	–0.83	0.41
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–4.78	2.77	–1.72	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–311.21	95.30	–3.27	0.00
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–202.89	93.10	–2.18	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	13.95	2.70	5.16	0.00
thinning:initSD.log:yrs.elapsed	0.37	0.16	2.25	0.02

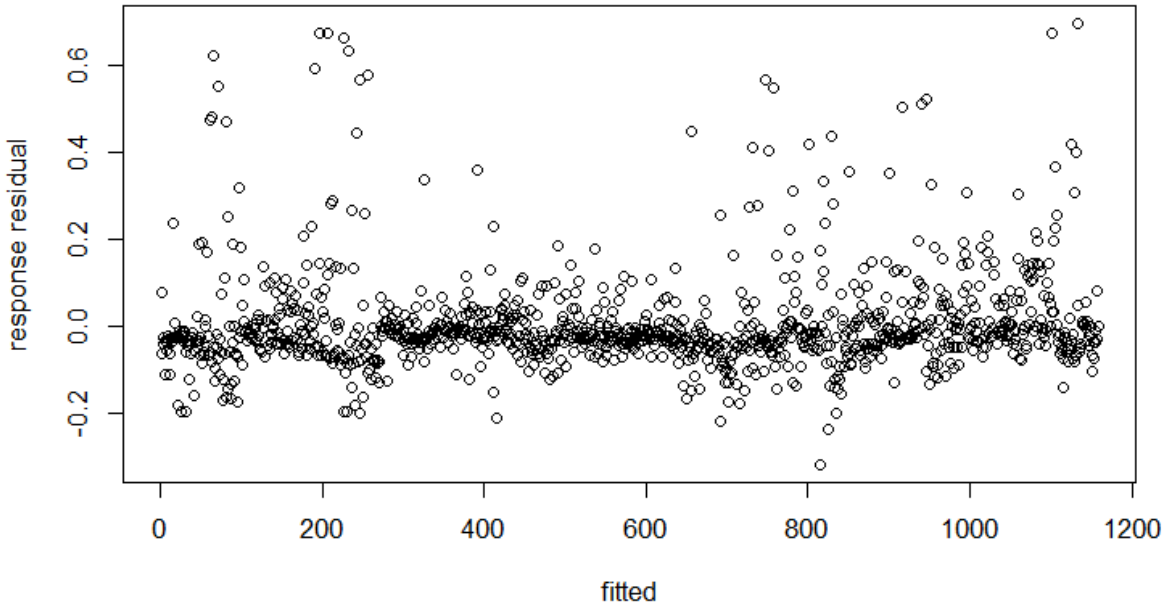

Figure 50 Fitted values and data residuals: live near surface vegetation cover

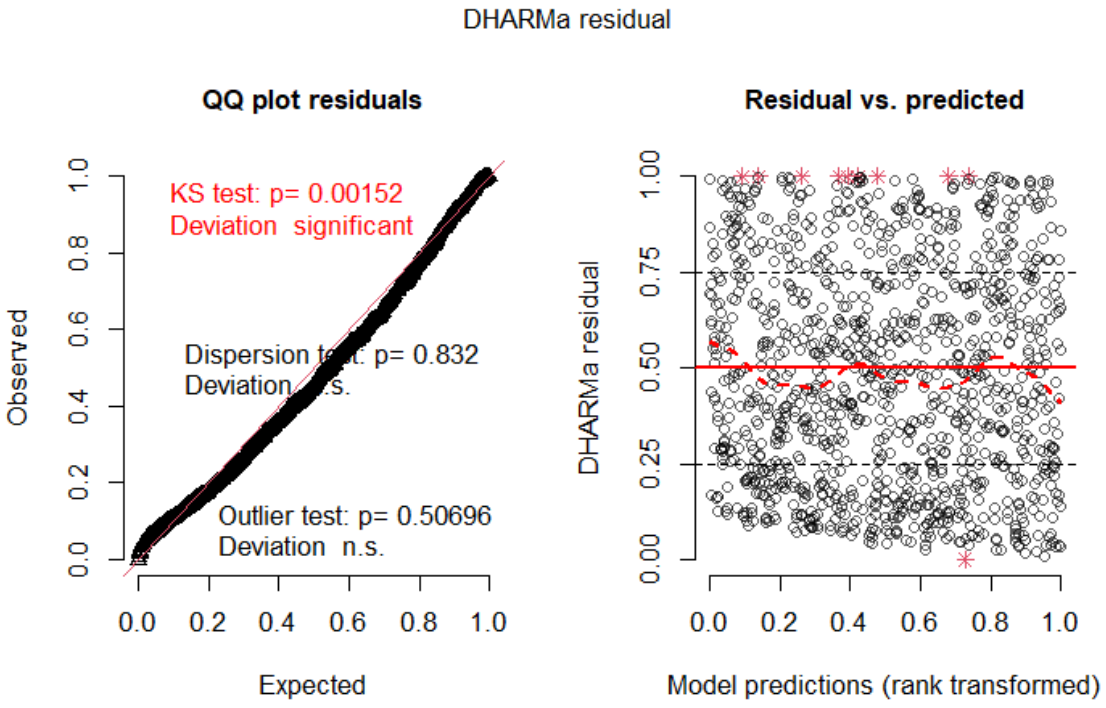

Figure 51 Simulated randomised quantile residuals: live near surface vegetation cover

13.6 Near surface fuel hazard: dead near surface vegetation

Table 28 Model fitting summary: dead near surface vegetation cover

Response	Per cent dead vegetation cover visually estimated for three 0.04 ha subplots in each 9-ha plot Positive continuous bounded (proportion) variable Modelled as the proportion of 100
Response transformation used	Values were expressed as a percentage and rounded to the nearest whole number
R package and function	glmmTMB
Distribution used	Binomial with a logit link
Outliers removed	None
Model reported	4_3_way
Random factors	0.04-hectare subplot
Other transformations compared	None
Other models attempted	Binomial • 4_way: Failed to converge • 3_way: Failed to converge • 3_way with no random effect of year.factor, site and/or siteplot: Failed to converge Tweedie • 4_way: Converged but had high failure rate in bootstrapping
Confidence comments	Low – moderate: • No fit warnings • Failed kurtosis-skewness, outlier and dispersion residual tests, with minor deviations from expectations • No failures or warnings in bootstrapped simulations

Model summary 25 Dead near surface vegetation cover

	Estimate	Std.Error	z.value	Pr.z
(Intercept)	–6.88814	0.572411	–12.0336	2.37E-33
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–114.325	20.58912	–5.55271	2.81E-08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–9.29728	1.685471	–5.51613	3.47E-08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–8.53332	3.372948	–2.52993	0.011409
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–300.46	86.14825	–3.48771	0.000487
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–1.84445	3.253754	–0.56687	0.570804
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–107.982	16.957	–6.36797	1.92E-10
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–3252.87	612.1241	–5.31408	1.07E-07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	206.045	55.37095	3.721175	0.000198
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–18.4525	1.301046	–14.1828	1.17E-45

site.qualitySQ2	–0.20744	0.123848	–1.67492	0.093949
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	12.79296	2.946622	4.34157	1.41E-05
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	8.89935	2.972355	2.99404	0.002753
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–2.02527	4.328113	–0.46793	0.639833
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	175.6478	117.1997	1.498706	0.13395
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–0.64177	4.061024	–0.15803	0.874433
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–1.91415	1.872913	–1.02202	0.306772
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–44.4129	71.13237	–0.62437	0.532385
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–481.048	66.52828	–7.23074	4.80E-13
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	12.90542	1.899034	6.795784	1.08E-11
thinning:initSD.log:yrs.elapsed	0.687602	0.126321	5.443311	5.23E-08

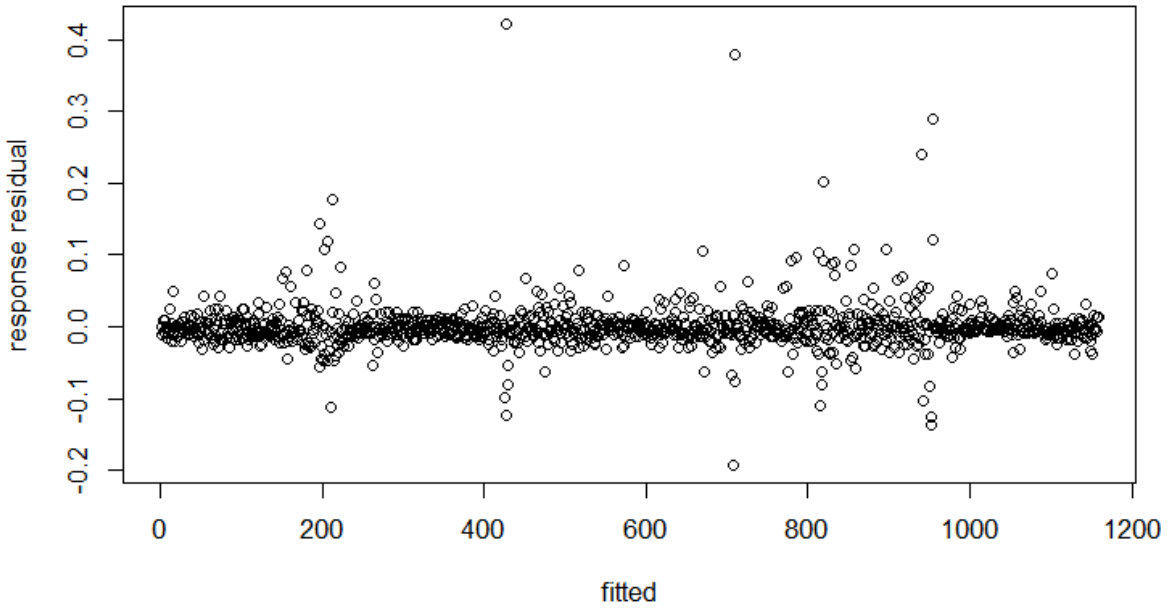

Figure 52 Fitted values and data residuals: dead near surface vegetation cover

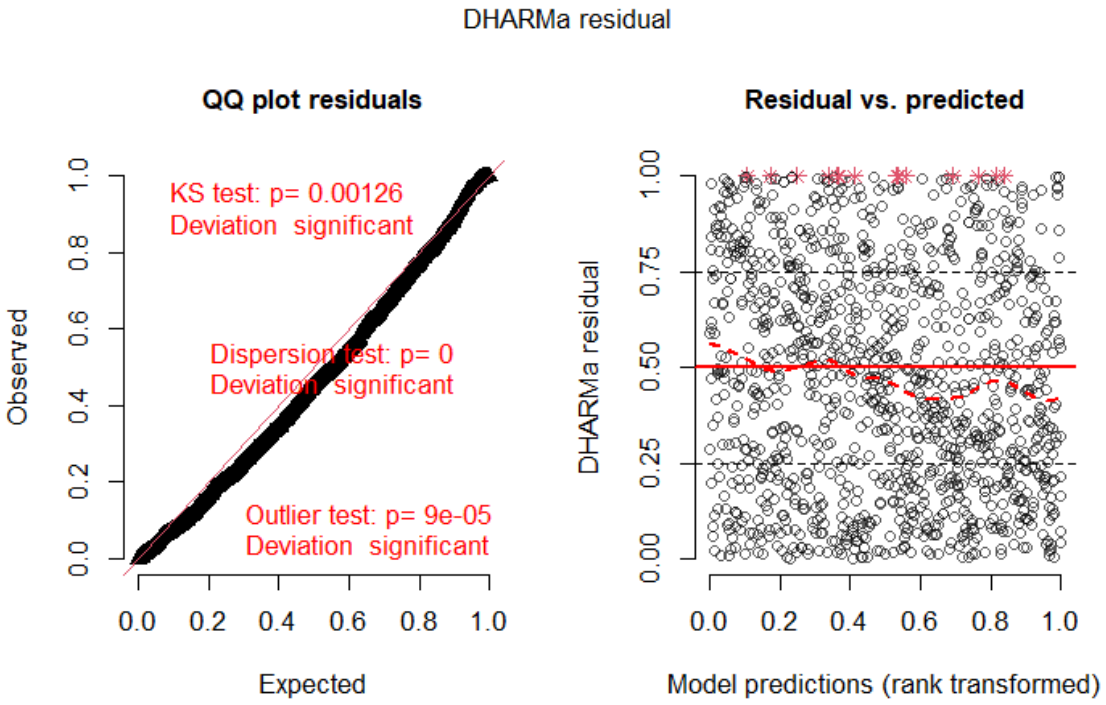

Figure 53 Simulated randomised quantile residuals: dead near surface vegetation cover

13.7 Near surface fuel hazard assessment

Table 29 Model fitting summary: near surface fuel hazard

Response	Probability of being in each near surface fuel hazard category per 0.04-hectare subplot Categorical variable
Response transformation used	None
R package and function	brm function from brms package with family specified as cratio(threshold = flexible)
Distribution used	Continuation ratio with flexible category thresholds The cumulative model has an underlying distribution that spans all categories, which is appropriate for fuel hazard because hazard is an underlying continuous variable and responses can move up and down as well as jump categories. (In contrast, an adjacent categories model assumes each level of risk rating has its own distribution, and sequential models assume response data can only move sequentially through the levels.) Flexible thresholds allow for the boundaries between hazard rating categories to have unequal sizes and account for different proportions of the data. This is supported by the input data where more sites report low or moderate ratings than high or very high ratings.
Outliers removed	None
Model reported	4_way, with iterations = 2000, chains = 4, warmup = 500, max tree depth = 15, priors for all betas = normal(0,10)
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots)

	Subplot (a factor over 198 subplots) Year.factor (a factor for each of the 5 survey years)
Other transformations compared	None
Other models attempted	None
Confidence comments	High confidence • No fit warnings or failures to converge • Chains mixed well

Model summary 26 Near surface fuel hazard

	Estimate	Est. Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Intercept[1]	–2.43	0.48	–3.44	–1.54	1.00	4846.90	5278.25
Intercept[2]	1.18	0.47	0.22	2.08	1.00	4715.28	5349.35
Intercept[3]	4.22	0.56	3.13	5.32	1.00	5533.29	5984.21
Intercept[4]	2.93	0.84	1.34	4.65	1.00	9264.14	9000.63
polycbindthinninginitSD.logyrs.elapsed21.0.0	–6.03	5.61	–17.06	4.87	1.00	11086.52	11359.71
polycbindthinninginitSD.logyrs.elapsed22.0.0	–3.17	3.98	–10.99	4.69	1.00	12703.62	10910.92
polycbindthinninginitSD.logyrs.elapsed20.1.0	–0.77	4.69	–10.03	8.38	1.00	12660.81	10633.19
polycbindthinninginitSD.logyrs.elapsed21.1.0	0.00	10.07	–19.77	19.60	1.00	28807.04	9425.62
polycbindthinninginitSD.logyrs.elapsed20.2.0	–3.17	4.62	–12.19	5.99	1.00	12665.96	11399.03
polycbindthinninginitSD.logyrs.elapsed20.0.1	–4.00	7.33	–17.65	11.21	1.00	12393.22	9462.53
polycbindthinninginitSD.logyrs.elapsed21.0.1	0.17	10.09	–19.68	20.00	1.00	31744.54	10008.38
polycbindthinninginitSD.logyrs.elapsed20.1.1	0.53	9.99	–18.85	20.22	1.00	28796.77	9149.73
polycbindthinninginitSD.logyrs.elapsed20.0.2	–16.95	5.07	–27.14	–7.13	1.00	9799.07	7450.60
site.qualitySQ2	–0.33	0.36	–1.07	0.39	1.00	9504.59	8434.50
polycbindthinninginitSD.logyrs.elapsed21.0.0:site.qualitySQ2	3.26	6.38	–9.18	15.67	1.00	13781.67	11647.58
polycbindthinninginitSD.logyrs.elapsed22.0.0:site.qualitySQ2	6.43	5.28	–3.93	16.68	1.00	16378.63	11254.42
polycbindthinninginitSD.logyrs.elapsed20.1.0:site.qualitySQ2	–0.70	5.94	–12.31	10.91	1.00	12478.61	9917.88
polycbindthinninginitSD.logyrs.elapsed21.1.0:site.qualitySQ2	–0.32	9.87	–19.42	19.02	1.00	30316.76	9916.17
polycbindthinninginitSD.logyrs.elapsed20.2.0:site.qualitySQ2	–2.87	5.67	–14.01	8.37	1.00	12980.83	10783.66
polycbindthinninginitSD.logyrs.elapsed20.0.1:site.qualitySQ2	–2.21	4.91	–11.73	7.50	1.00	14789.15	10719.67
polycbindthinninginitSD.logyrs.elapsed21.0.1:site.qualitySQ2	0.07	10.03	–19.48	19.80	1.00	31119.13	10255.82
polycbindthinninginitSD.logyrs.elapsed20.1.1:site.qualitySQ2	–2.21	9.84	–21.74	16.99	1.00	27119.49	10139.97
polycbindthinninginitSD.logyrs.elapsed20.0.2:site.qualitySQ2	15.09	4.12	7.01	23.14	1.00	17931.13	11614.84
thinning:initSD.log:yrs.elapsed	0.01	0.03	–0.05	0.07	1.00	8493.36	9720.24
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	0.01	0.03	–0.06	0.07	1.00	9752.14	10408.39

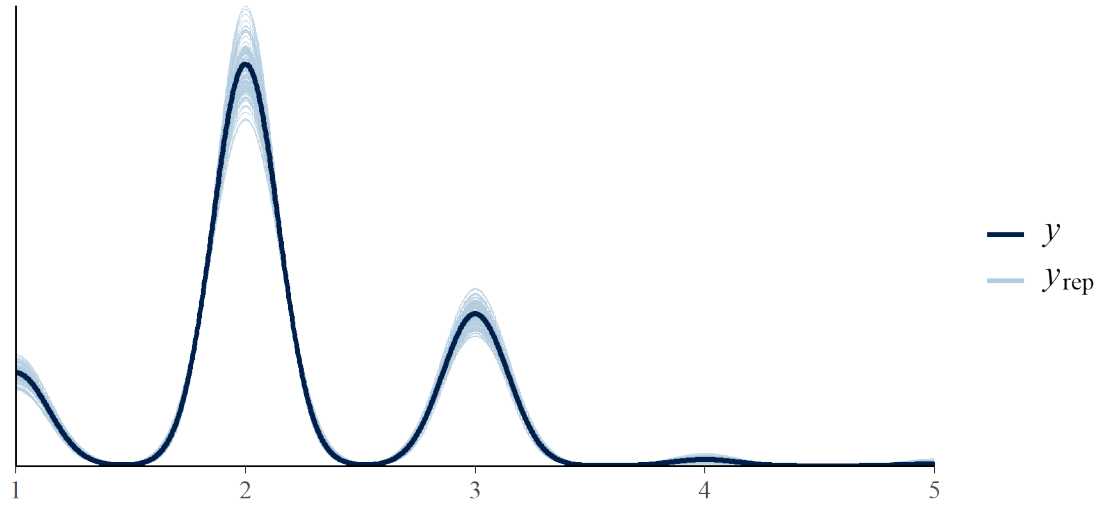

Figure 54 Observed data (y) and 100 draws from the model posterior distribution (yrep) for near surface fuel hazard

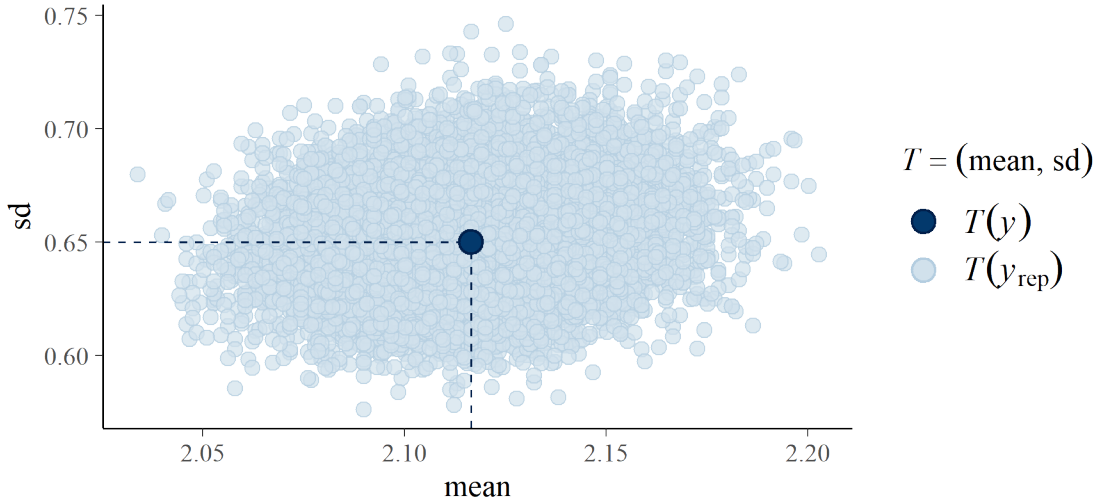

Figure 55 Near surface fuel hazard posterior mean and standard deviation

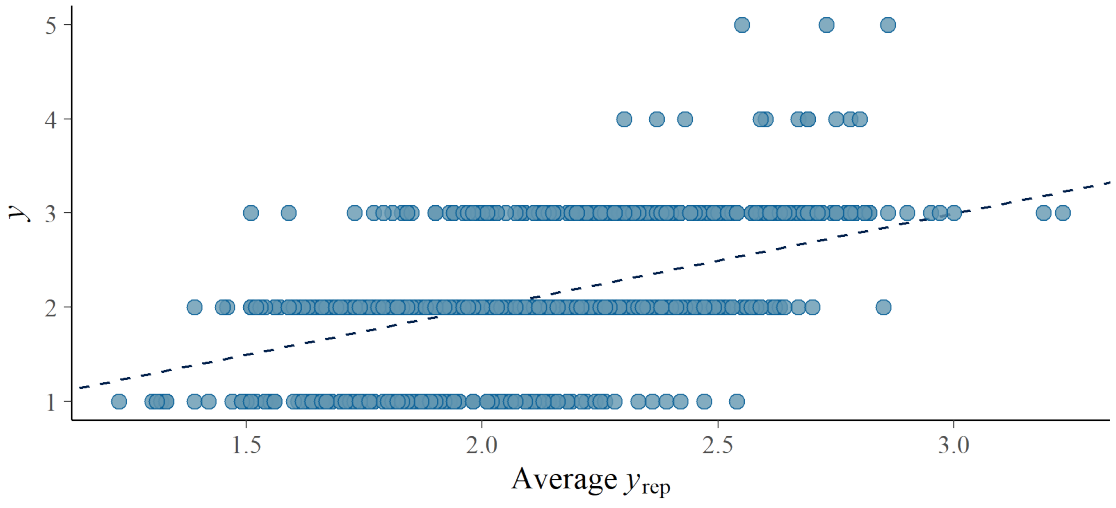

Figure 56 Near surface fuel hazard posterior average scatter plot

13.8 Combined surface and near surface fuel hazard assessment

Table 30 Model fitting summary: combined surface and near surface fuel hazard

Response	Probability of being in each combined surface and near surface fuel hazard category for each 0.04-hectare subplot Categorical variable
Response transformation used	None
R package and function	brm function from brms package with family specified as cratio(threshold = flexible)
Distribution used	Continuation ratio with flexible category thresholds The cumulative model has an underlying distribution that spans all categories, which is appropriate for fuel hazard because hazard is an underlying continuous variable and responses can move up and down as well as jump categories. (In contrast, an adjacent categories model assumes each level of risk rating has its own distribution, and sequential models assume response data can only move sequentially through the levels.) Flexible thresholds allow for the boundaries between hazard rating categories to have unequal sizes and account for different proportions of the data. This is supported by the input data where more sites report very high ratings than low, moderate or extreme ratings.
Outliers removed	None
Model reported	4_way, with iterations = 2000, chains = 4, warmup = 500, max tree depth = 15, priors for all betas = normal(0,10)
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Subplot (a factor over 198 subplots) Year.factor (a factor for each of the 5 survey years)
Other transformations compared	None
Other models attempted	None
Confidence comments	Moderate confidence • No fit warnings • Good chain mixing • Rhat all = 1 • Correlation between standard deviation and mean of posterior distribution

Model summary 27 Combined surface and near surface fuel hazard

	Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Intercept[1]	–4.14	0.55	–5.19	–3.00	1.00	1013.10	825.66
Intercept[2]	–1.71	0.53	–2.70	–0.57	1.00	976.42	718.68
Intercept[3]	–1.27	0.53	–2.25	–0.12	1.01	948.49	768.80

Intercept[4]	3.93	0.55	2.90	5.10	1.00	1003.37	791.21
polycbindthinninginitSD.logyrs.elapsed21.0.0	–2.05	5.75	–13.62	9.00	1.00	4898.20	4954.06
polycbindthinninginitSD.logyrs.elapsed22.0.0	–3.63	4.61	–12.62	5.39	1.00	4902.46	4668.42
polycbindthinninginitSD.logyrs.elapsed20.1.0	3.25	5.67	–7.77	14.48	1.00	3721.78	3825.60
polycbindthinninginitSD.logyrs.elapsed21.1.0	0.04	9.86	–19.25	19.24	1.00	12110.17	4677.03
polycbindthinninginitSD.logyrs.elapsed20.2.0	–0.83	5.71	–11.98	10.19	1.00	3938.12	4138.68
polycbindthinninginitSD.logyrs.elapsed20.0.1	1.58	7.73	–14.53	15.82	1.00	3958.86	3884.71
polycbindthinninginitSD.logyrs.elapsed21.0.1	0.11	10.27	–19.88	20.04	1.00	10644.95	4122.15
polycbindthinninginitSD.logyrs.elapsed20.1.1	–0.59	10.19	–20.43	19.24	1.00	10736.34	4191.74
polycbindthinninginitSD.logyrs.elapsed20.0.2	1.49	4.53	–7.25	10.29	1.00	5922.23	4119.41
site.qualitySQ2	–0.14	0.40	–0.92	0.66	1.00	3974.91	4017.89
polycbindthinninginitSD.logyrs.elapsed21.0.0:site.qualitySQ2	–13.02	6.56	–25.74	–0.24	1.00	5211.56	4393.82
polycbindthinninginitSD.logyrs.elapsed22.0.0:site.qualitySQ2	8.32	5.85	–3.08	19.56	1.00	6677.73	4282.18
polycbindthinninginitSD.logyrs.elapsed20.1.0:site.qualitySQ2	0.40	7.02	–13.22	14.22	1.00	4334.46	4321.50
polycbindthinninginitSD.logyrs.elapsed21.1.0:site.qualitySQ2	0.76	10.19	–19.38	20.48	1.00	12865.61	4232.46
polycbindthinninginitSD.logyrs.elapsed20.2.0:site.qualitySQ2	–5.97	6.62	–18.85	7.08	1.00	4149.65	4392.26
polycbindthinninginitSD.logyrs.elapsed20.0.1:site.qualitySQ2	–1.28	4.76	–10.56	8.06	1.00	5975.91	5047.96
polycbindthinninginitSD.logyrs.elapsed21.0.1:site.qualitySQ2	0.58	10.06	–19.33	19.89	1.00	11130.34	4284.51
polycbindthinninginitSD.logyrs.elapsed20.1.1:site.qualitySQ2	–0.84	10.13	–20.72	18.78	1.00	11712.04	4009.13
polycbindthinninginitSD.logyrs.elapsed20.0.2:site.qualitySQ2	5.97	4.01	–1.90	13.97	1.00	7356.72	4523.17
thinning:initSD.log:yrs.elapsed	0.01	0.03	–0.04	0.07	1.00	4770.74	4783.85
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	0.05	0.03	–0.01	0.12	1.00	4688.95	4165.00

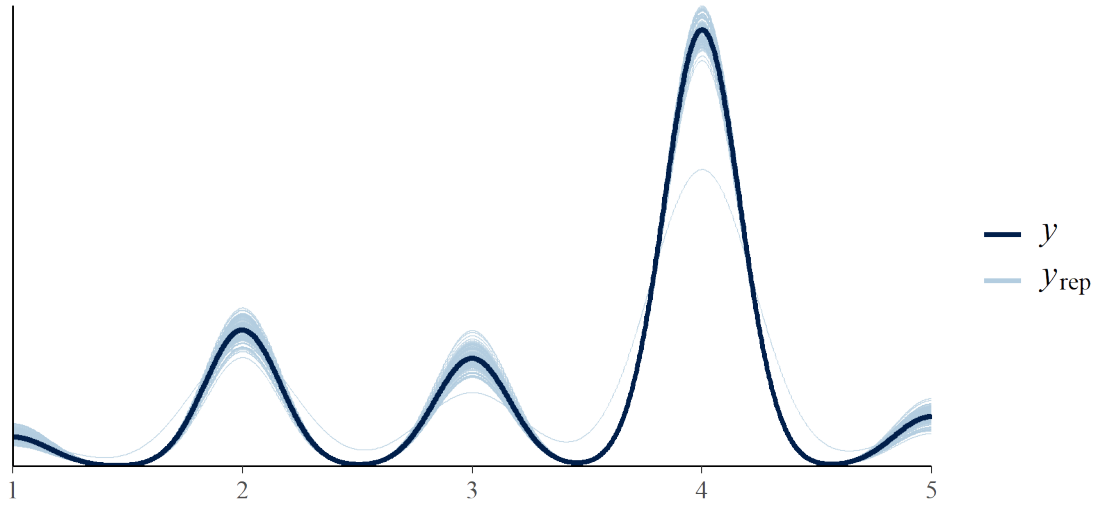

Figure 57 Observed data (y) and 100 draws from the model posterior distribution (yrep) for combined surface and near surface fuel hazard

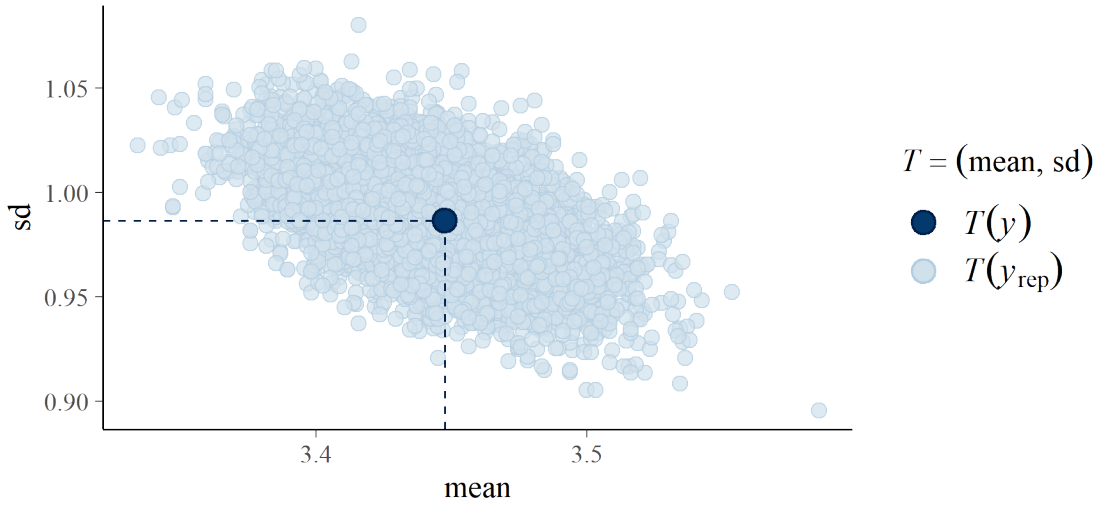

Figure 58 Combined surface and near surface fuel hazard posterior mean and standard deviation

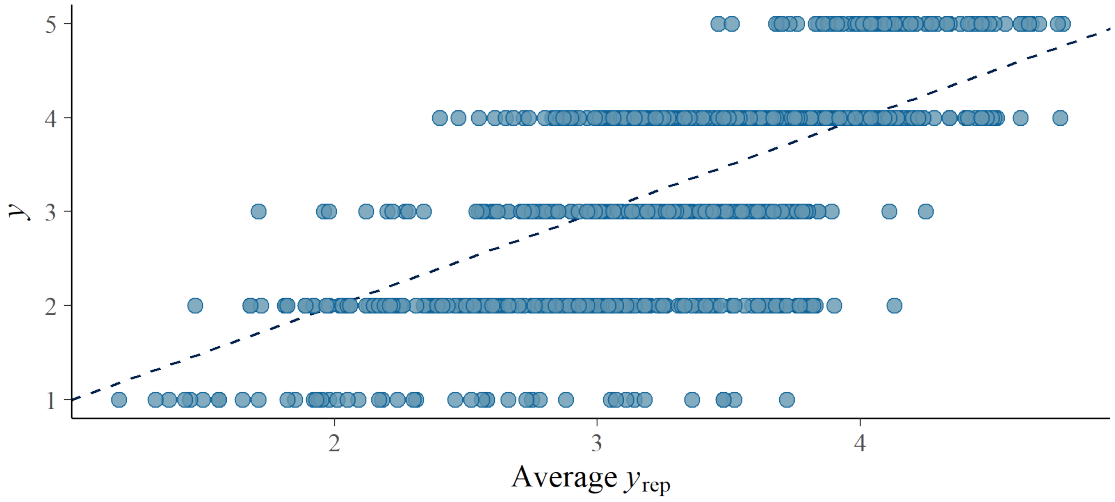

Figure 59 Combined surface and near surface fuel hazard posterior average scatter plot

13.9 Elevated fuel hazard: live elevated vegetation cover

Table 31 Model fitting summary: live elevated vegetation cover

Response	Per cent cover of live elevated vegetation cover per 0.04-hectare subplot Positive continuous bounded (proportion) variable
Response transformation used	NA
R package and function	NA
Distribution used	NA
Outliers removed	NA

Model reported	No model reported
Random factors	NA
Other transformations compared	NA
Other models attempted	Binomial distribution 4_way: Failed to converge, pattern in residuals with years elapsed 4_way: no year.factor: Failed to converge, residuals worse 3_way: Failed to converge 3_way no year.factor, site, and/or siteplot random effects 3_way no years elapsed, year.factor as fixed effect: Failed to converge although residuals showed good fit Beta distribution – zeroes (12% of the data) were converted to 0.001 4_way: Failed to converge 3_way: Failed to converge 3_way with no year.factor, site or siteplot random effects: Fit but >25% failure rate in bootstrapping simulations
Confidence comments	NA

13.10 Elevated fuel hazard: dead elevated vegetation cover

Not modelled.

13.11 Elevated fuel hazard assessment

Table 32 Model fitting summary: elevated fuel hazard

Response	Probability of being in each elevated fuel hazard category per 0.04-hectare subplot Categorical variable
Response transformation used	None
R package and function	brm function from brms package with family specified as cratio(threshold = flexible)
Distribution used	Continuation ratio with flexible category thresholds The cumulative model has an underlying distribution that spans all categories, which is appropriate for fuel hazard because hazard is an underlying continuous variable and responses can move up and down as well as jump categories. (In contrast, an adjacent categories model assumes each level of risk rating has its own distribution, and sequential models assume response data can only move sequentially through the levels.) Flexible thresholds allow for the boundaries between hazard rating categories to have unequal sizes and account for different proportions of the data. This is supported by the input data where more sites report very high ratings than low, moderate or extreme ratings.
Outliers removed	None

Model reported	4_way, with iterations = 2000, chains = 4, warmup = 500, max tree depth = 15, priors for all betas = normal(0,10)
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Subplot (a factor over 198 subplots) Year.factor (a factor for each of the 5 survey years)
Other transformations compared	None
Other models attempted	None
Confidence comments	High confidence • No fit warnings or failures to converge • Chains mixed well

Model summary 28 Elevated fuel hazard

	Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Intercept[1]	0.04	0.87	–1.78	1.67	1.00	1433.26	2394.62
Intercept[2]	7.77	1.16	5.47	10.10	1.00	1886.19	2929.91
polycbindthinninginitSD.logyrs.elapsed21.0.0	7.20	5.98	–4.40	18.90	1.00	4376.29	4135.07
polycbindthinninginitSD.logyrs.elapsed22.0.0	1.82	4.37	–6.68	10.40	1.00	4303.56	4346.96
polycbindthinninginitSD.logyrs.elapsed20.1.0	–10.52	5.06	–20.22	–0.31	1.00	3535.42	4117.03
polycbindthinninginitSD.logyrs.elapsed21.1.0	0.85	9.77	–18.36	19.97	1.00	10620.23	4346.02
polycbindthinninginitSD.logyrs.elapsed20.2.0	0.06	4.98	–9.59	9.93	1.00	4237.63	4432.88
polycbindthinninginitSD.logyrs.elapsed20.0.1	8.77	9.49	–10.11	27.05	1.00	5293.23	4041.64
polycbindthinninginitSD.logyrs.elapsed21.0.1	–0.56	10.17	–20.28	19.05	1.00	9429.58	4007.22
polycbindthinninginitSD.logyrs.elapsed20.1.1	–0.47	10.19	–20.25	19.36	1.00	9629.55	3956.47
polycbindthinninginitSD.logyrs.elapsed20.0.2	–11.81	6.37	–24.36	0.34	1.00	7431.43	4697.89
site.qualitySQ2	0.59	0.38	–0.13	1.32	1.00	3210.91	3672.30
polycbindthinninginitSD.logyrs.elapsed21.0.0 :site.qualitySQ2	–2.35	6.94	–16.25	11.24	1.00	4130.69	4411.80
polycbindthinninginitSD.logyrs.elapsed22.0.0 :site.qualitySQ2	7.05	5.78	–4.22	18.53	1.00	5129.66	4782.00
polycbindthinninginitSD.logyrs.elapsed20.1.0 :site.qualitySQ2	10.32	6.27	–2.32	22.29	1.00	4720.44	4571.29
polycbindthinninginitSD.logyrs.elapsed21.1.0 :site.qualitySQ2	0.72	9.93	–19.00	20.64	1.00	10908.42	4086.03
polycbindthinninginitSD.logyrs.elapsed20.2.0 :site.qualitySQ2	1.98	5.98	–9.75	13.91	1.00	4128.05	4624.88
polycbindthinninginitSD.logyrs.elapsed20.0.1 :site.qualitySQ2	5.19	7.03	–8.55	18.83	1.00	5783.61	4749.56
polycbindthinninginitSD.logyrs.elapsed21.0.1 :site.qualitySQ2	–0.13	9.99	–19.84	19.19	1.00	9590.01	3961.44
polycbindthinninginitSD.logyrs.elapsed20.1.1 :site.qualitySQ2	–0.65	9.88	–19.84	18.09	1.00	10841.05	4304.38
polycbindthinninginitSD.logyrs.elapsed20.0.2 :site.qualitySQ2	12.66	5.93	1.24	24.34	1.00	7592.53	4893.14
thinning:initSD.log:yrs.elapsed	–0.01	0.03	–0.08	0.06	1.00	3709.53	4348.01
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	–0.03	0.04	–0.11	0.05	1.00	3198.32	4029.69

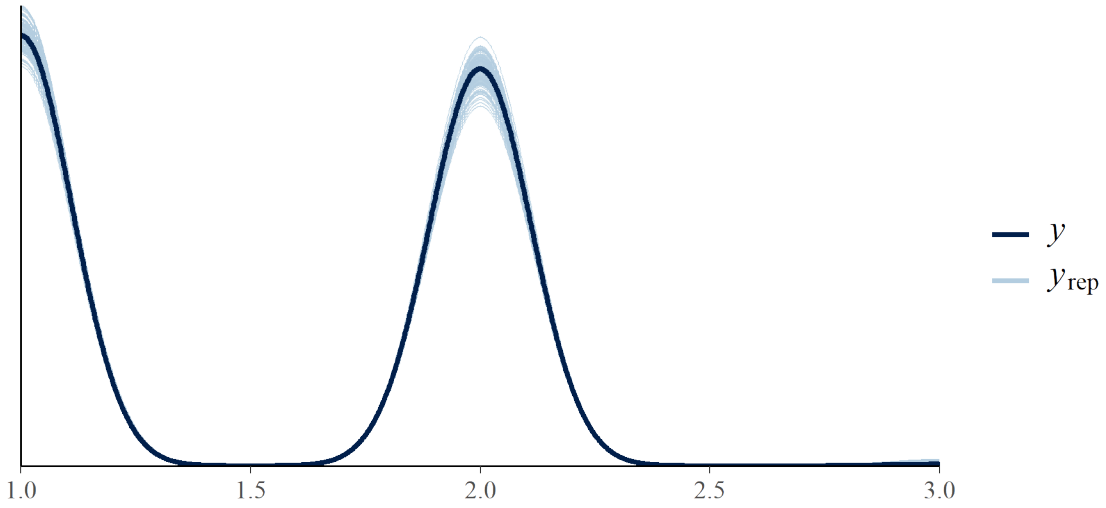

Figure 60 Observed data (y) and 100 draws from the model posterior distribution (yrep) for elevated fuel hazard

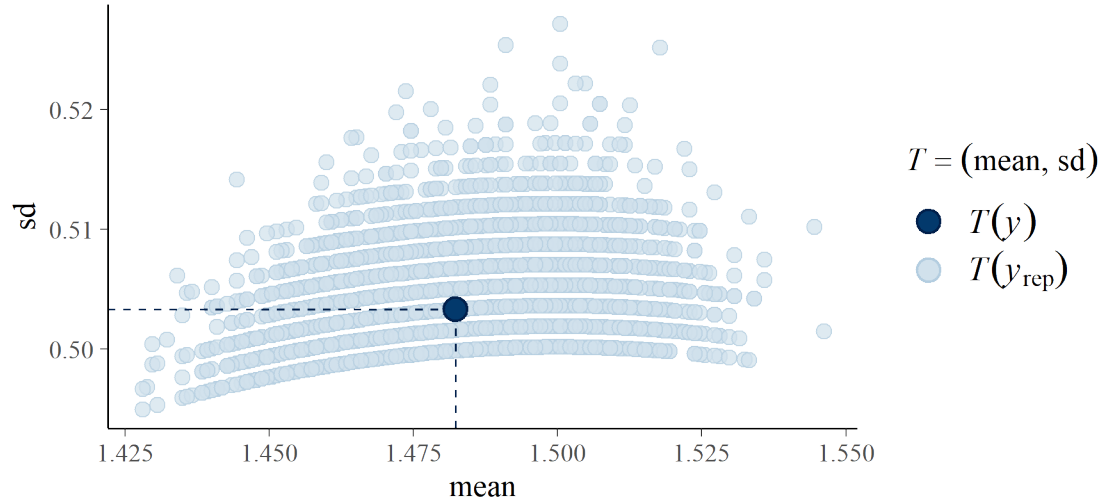

Figure 61 Elevated fuel hazard posterior mean and standard deviation

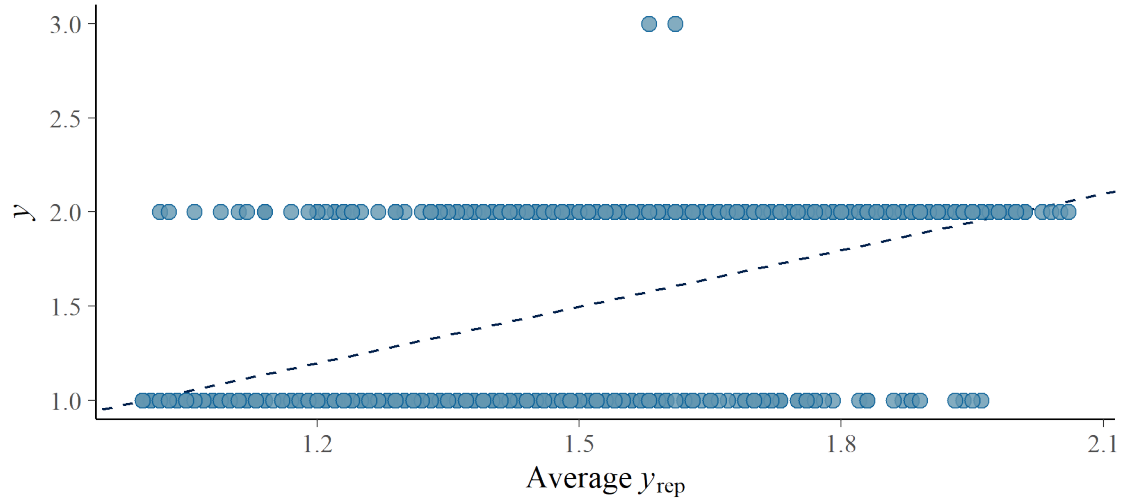

Figure 62 Elevated fuel hazard posterior average scatter plot

14. Model summaries: Bats

14.1 Bat species richness

Table 33 Model fitting summary: Bat species richness

Response	A count of positively identified unique bat species calls per 9-hectare plot in each site, for each survey year. Some bat species calls within a genus are indistinguishable and were identified to a genus level. A positive integer variable.
Response transformation used	NA
R package and function	lmer function from lme4 package
Distribution used	NA
Outliers removed	NA
Reported model formula	No model reported
Random factors	NA
Other transformations compared	Tukey Ladder of powers using the 'transformTukey' function.
Other models attempted	Gaussian • 3_way with year.factor as fixed effect: Model converged but failed all residual tests • 3_way with year.factor as fixed effect and Tukey transformed response: Model converged and improved fit but still failed most residual tests • 3_way with year.factor as fixed effect, Tukey transformed response, remove siteplot random effect: Model converged and improved fit but still failed most residual tests
Confidence comments	NA

14.2 Bat species diversity

Table 34 Model fitting summary: Bat species Hill-Shannon diversity

Response	A Hill-Shannon diversity value was calculated for the abundance of positively identified bat species per night per 9-hectare plot. Surveys were conducted for 3 consecutive nights each survey year. Positive continuous variable
Response transformation used	None
R package and function	lmer function from lme4 package

Distribution used	Gaussian
Outliers removed	No
Reported model formula	4_way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 7 survey years)
Other transformations compared	None
Other models attempted	None
Confidence comments	Moderate confidence: • No convergence or fit warnings • Very minor deviation from expected in outlier test • ~ 49% boundary fit warnings but no non-convergence out of 999 bootstrapped simulations for confidence interval calculations

Model summary 29 Bat species Hill-Shannon diversity

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	5.66	1.25	1211.14	4.55	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	61.08	45.72	1226.96	1.34	0.18
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–2.8	3.09	268.25	–0.91	0.36
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	1.77	5.74	143.17	0.31	0.76
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	503.05	165.09	806.53	3.05	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–4.78	4.85	60.03	–0.99	0.33
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	61.65	42.75	1229.5	1.44	0.15
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	2197.17	1577.02	1240.03	1.39	0.16
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–46.68	100.63	1073.63	–0.46	0.64
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	0	2.7	97.08	0	1
site.qualitySQ2	–2.83	1.49	1240.45	–1.9	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–99.94	54.42	1240.52	–1.84	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–9.05	5.05	269.44	–1.79	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–4.62	7.57	134.31	–0.61	0.54
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–499.93	225.65	653.66	–2.22	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	11.11	5.95	59.45	1.87	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–108.41	50.99	1242.99	–2.13	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–3921.86	1868.34	1243.11	–2.1	0.04
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	104.6	120.88	1114.2	0.87	0.39
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	0.05	2.73	1236.19	0.02	0.99
thinning:initSD.log:yrs.elapsed	–0.39	0.3	1238.81	–1.3	0.19
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	0.74	0.36	1243.46	2.02	0.04

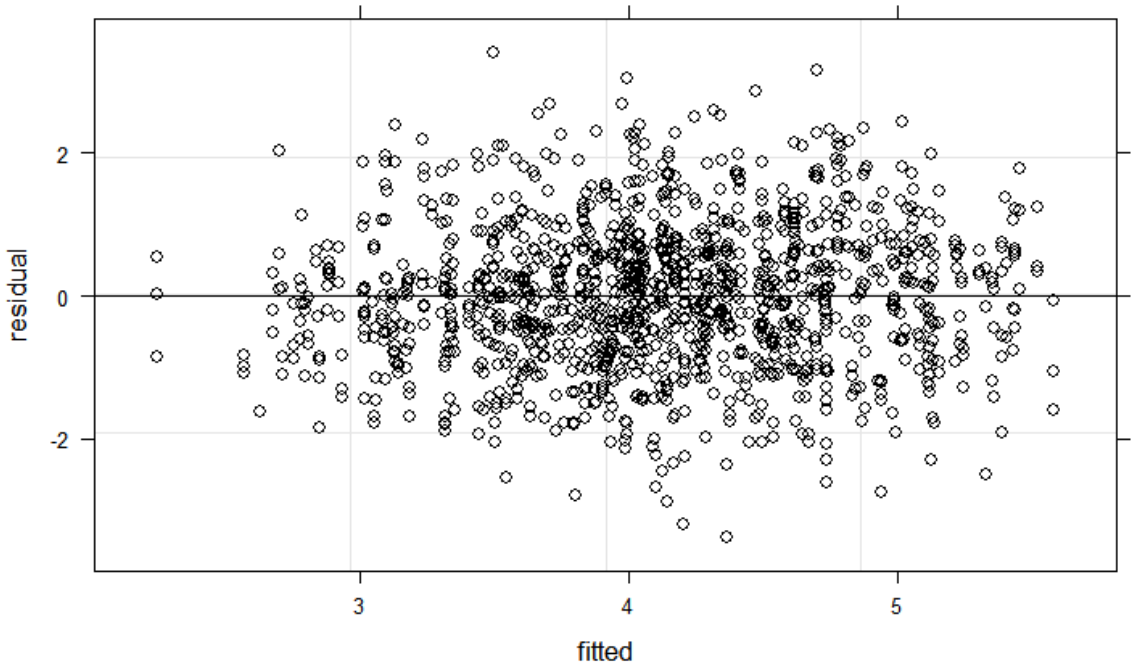

Figure 63 Fitted values and data residuals: bat species Hill-Shannon diversity

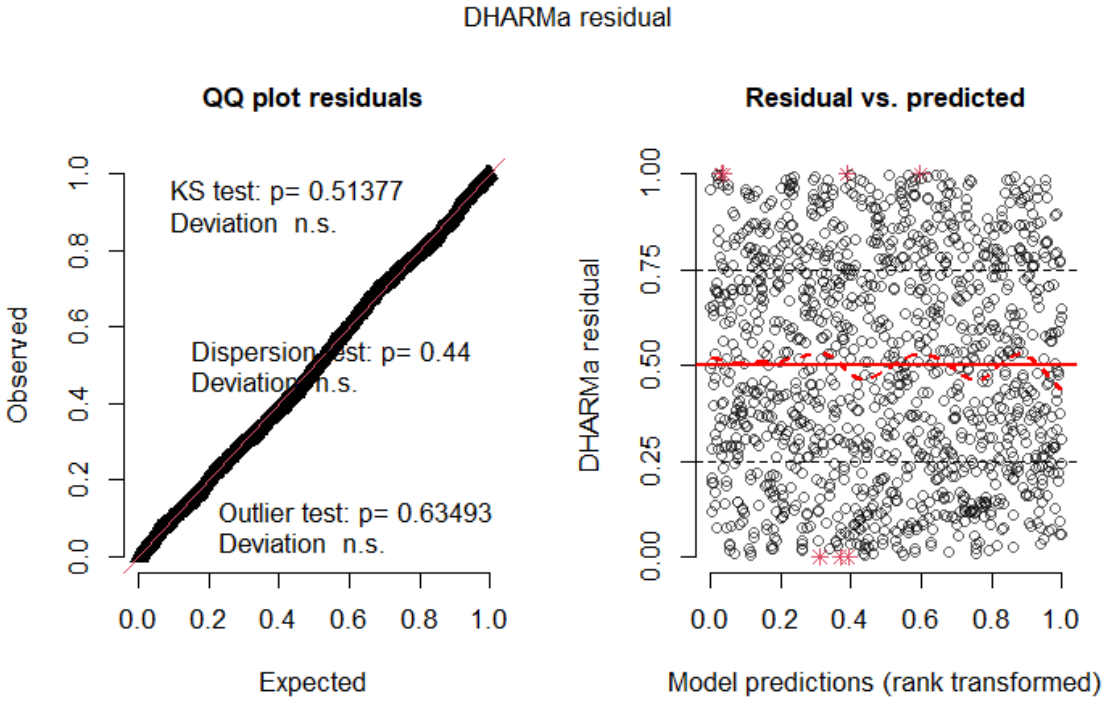

Figure 64 Simulated randomised quantile residuals: bat species Hill-Shannon diversity

14.3 Total bat activity

Table 35 Model fitting summary: Total bat activity

Response	Total bat calls per night per 9-hectare plot, surveys were conducted for 3 consecutive nights each survey year Positive integer variable
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Negative binomial with quadratic parameterisation
Outliers removed	None
Reported model formula	4_3_way
Random factors	Year factor (a factor over 7 surveys) Site (a factor over 22 sites) Siteplot (a factor over 66 plots)
Other transformations compared	Yes
Other models attempted	Gaussian • 4_way: Very poor fit Gaussian with transformation • 4_way with square root: Poor model fit • 4_way with log(var +1): Improved fit, but not comparable to reported model. Poisson • 4_way: Model fit but failed all residual tests • 3_way with no year.factor or site random effects: Fit but failed all residual tests Negative binomial: • 4_way: Model failed to converge • 3_way with no year factor: Comparable fit to the reported model • 3_way with year.factor as a fixed effect and no years.elapsed: Model failed to converge
Confidence comments	Low – moderate: • No fit warnings • Failed kurtosis-skewness test with minor deviations from expected but passed other residual tests • ~2% failure to converge out of 999 bootstrapped simulations

Model summary 30 Bat activity

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr...z..
(Intercept)	4.66	0.45	10.3	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–29.25	16.85	–1.74	0.08

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–1.56	1.65	–0.95	0.34
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–0.61	3.01	–0.2	0.84
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–162.3	90.78	–1.79	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–0.19	2.53	–0.07	0.94
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–26.33	15.17	–1.74	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–1228.67	583.48	–2.11	0.04
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	86.82	51.31	1.69	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	2.01	1.87	1.07	0.28
site.qualitySQ2	–0.07	0.16	–0.4	0.69
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–3.64	2.5	–1.46	0.15
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	3.96	2.75	1.44	0.15
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–1.61	3.61	–0.45	0.66
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	11.75	112.85	0.1	0.92
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	1.93	3.04	0.63	0.53
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	1.61	1.81	0.89	0.37
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	5.1	73.83	0.07	0.94
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–102.56	58.79	–1.74	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	2.35	1.75	1.34	0.18
thinning:initSD.log:yrs.elapsed	0.25	0.11	2.16	0.03

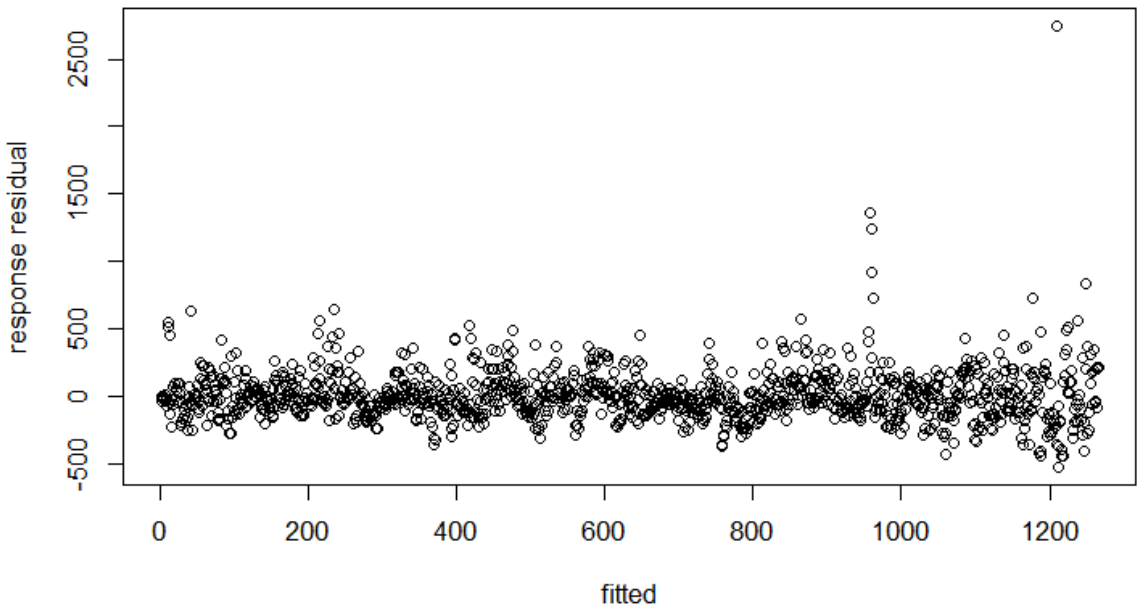

Figure 65 Fitted values and data residuals: total bat activity

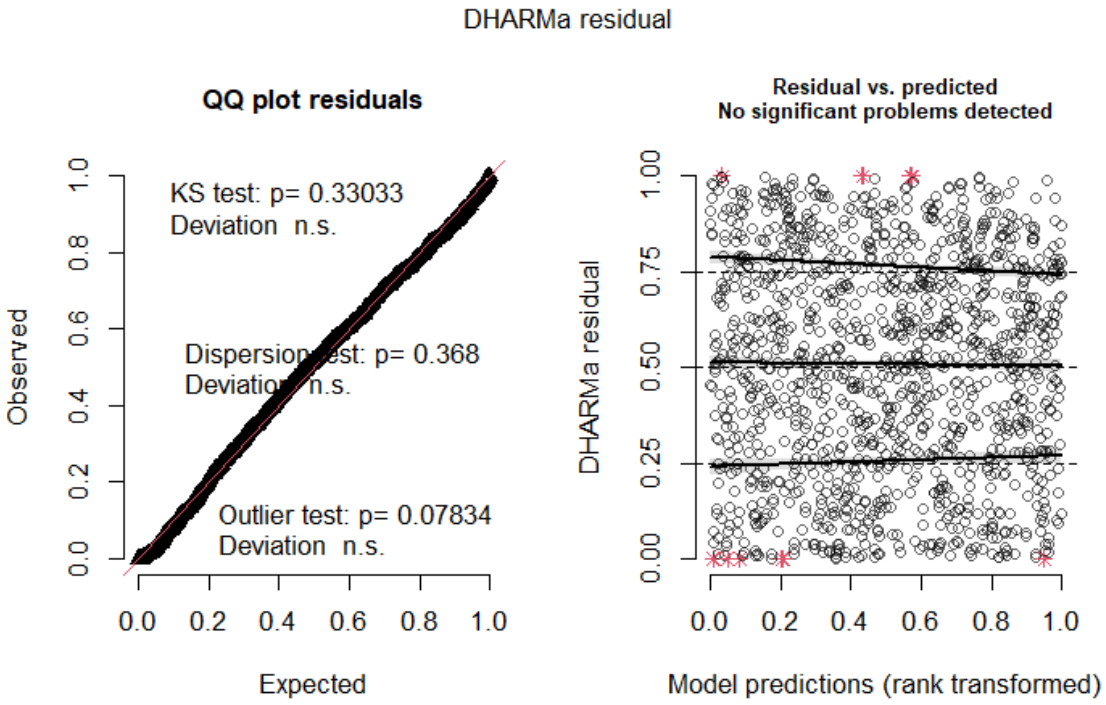

Figure 66 Simulated randomised quantile residuals: total bat activity

14.4 Bat guild activity: clutter specialists

Table 36 Model fitting summary: Bat guild activity – clutter specialists

Response	A count of all *Nyctophilus* genus bat calls per night per 9-hectare plot. Surveys were conducted for 3 consecutive nights each survey year. Positive integer variable
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Negative binomial with a quadratic parameterisation
Outliers removed	None
Reported model formula	4_3_way
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 7 survey years)
Other transformations compared	None
Other models attempted	Poisson • 4_way: Failed to converge Negative binomial • 4_way: Failed to converge

	• 4_way no year factor: Failed to converge • 3_way no site: Fit, but predictions were erroneous as above • 3_way no year factor: Fit, but predictions were erroneous as above • 2_way year factor as fixed effect and no years elapsed: Failed to converge
Confidence comments	Low – moderate: • Trouble fitting year-to-year variation • Failed dispersion test but passed other residual tests • 8% failure to converge in 999 bootstrapped simulations

Model summary 31 Bat guild activity – clutter specialists

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr.za
(Intercept)	1.35	0.58	2.34	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–35.84	21.36	–1.68	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	3.62	2.13	1.7	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–4.71	3.71	–1.27	0.2
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	85	114.52	0.74	0.46
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	5.38	3.31	1.63	0.1
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–29.65	19.77	–1.5	0.13
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–779.71	736.22	–1.06	0.29
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–124.54	64.46	–1.93	0.05
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–3.67	2.4	–1.53	0.13
site.qualitySQ2	–0.36	0.15	–2.39	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	8.66	3.24	2.67	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–6.72	3.51	–1.92	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	6.43	4.73	1.36	0.17
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–255.99	144.7	–1.77	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–6.83	4.02	–1.7	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	7.79	2.24	3.48	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–98.92	93.31	–1.06	0.29
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	146.6	72.73	2.02	0.04
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	3.18	2.17	1.47	0.14
thinning:initSD.log:yrs.elapsed	0.18	0.14	1.26	0.21

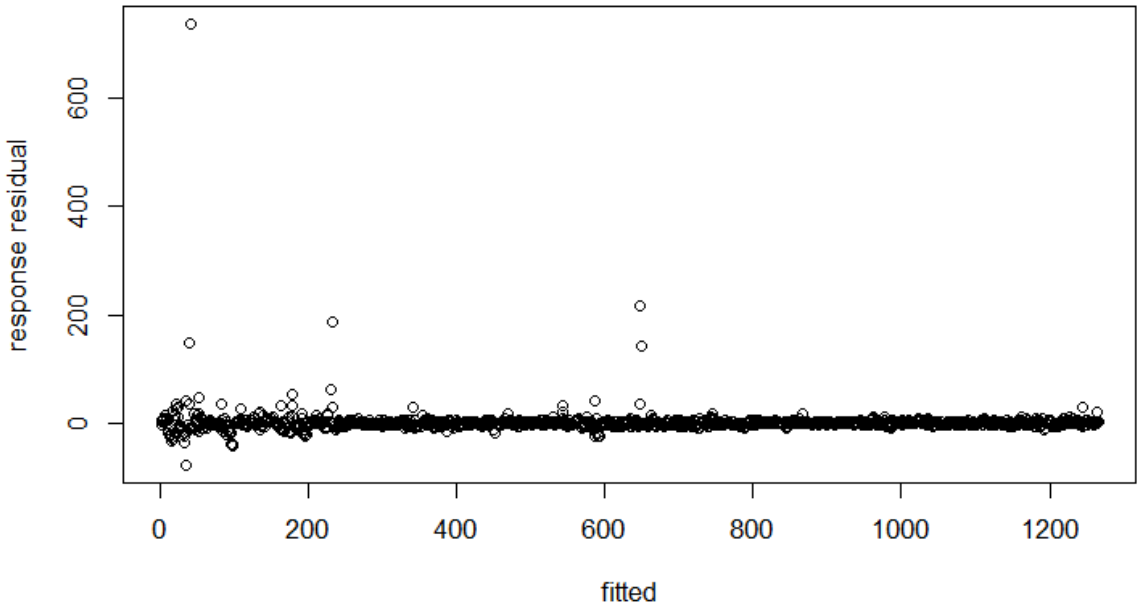

Figure 67 Fitted values and data residuals: bat guild activity for clutter specialists

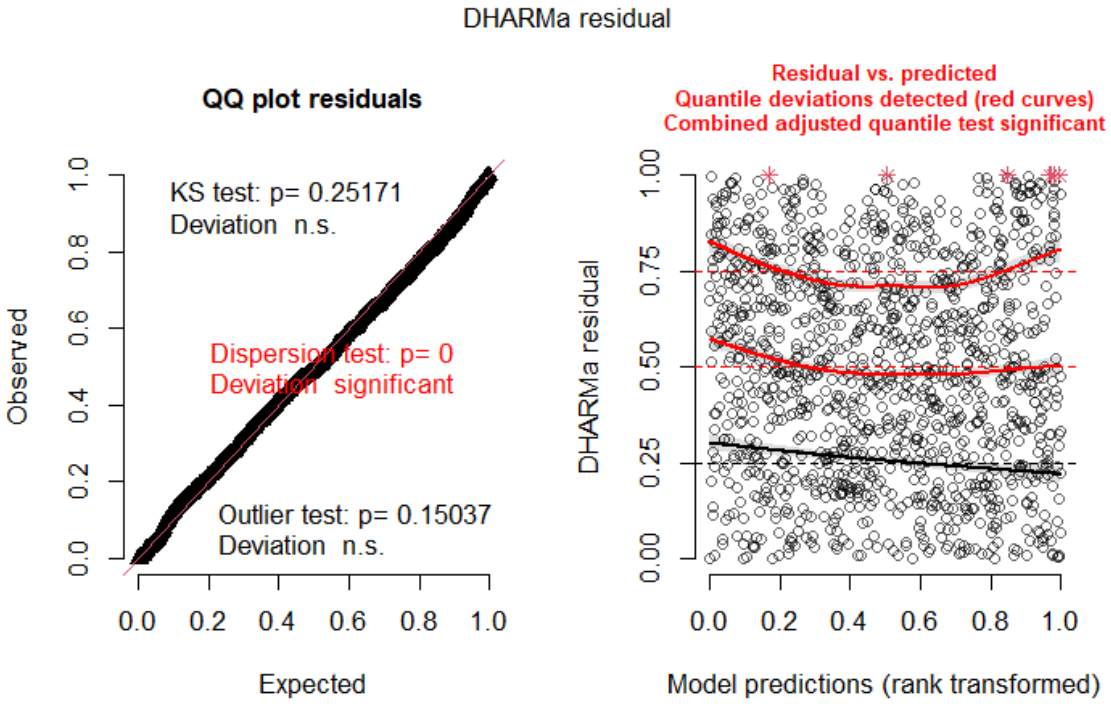

Figure 68 Simulated randomised quantile residuals: bat guild activity for clutter specialists

14.5 Bat guild activity: clutter avoiders

Table 37 Model fitting summary: Bat guild activity – clutter avoiders

Response	A count of calls for all clutter avoiding bat species positively identified per night per 9-hectare plot. Surveys were conducted for 3 consecutive nights each survey year. Positive integer variable
Response transformation used	None
R package and function	glmmTMB function from the glmmTMB package
Distribution used	Negative binomial, linear parameterisation (nb1)
Outliers removed	None
Reported model formula	4_3_way
Random factors	Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 7 survey years)
Other transformations compared	None
Other models attempted	Negative binomial, quadratic parameterisation (nb2): • 4_way_nb2: Model convergence failure • 3_way_nb2: Model converged but failed residuals tests Negative binomial, linear parameterisation (nb1): • 4_way_nb1: Model convergence failure • 4_way_nb1_noyr: Model convergence failure • 4_way_nb1_nofr_nosite: Model convergence failure • 3_way_nb1: Model converged but bootstrapped simulations failed • 3_way_nb1_nosite: Model had comparable fit to the reported model, but did not include three way interaction between thinning, initial tree density and yrs.elapsed. Replacing yrs.elapsed as a fixed effect with year.factor: • 4_way_nb1_yrfac: Model convergence failure • 3_way_nb1_ yrfac: Model convergence failure
Confidence comments	Moderate to high confidence: • No convergence or fit warnings • Minor deviation from expected in Kurtosis-Skewness test • <2% non-convergence or boundary fit warnings out of 999 bootstrapped simulations for confidence interval calculations

Model summary 32 Bat guild activity – clutter avoiders

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr.z.
(Intercept)	4.44	0.41	10.94	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–16.16	15.44	–1.05	0.3
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–3.56	1.87	–1.9	0.06

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–3.98	3.16	–1.26	0.21
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	44.2	89.88	0.49	0.62
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	3.34	3.12	1.07	0.28
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–15.9	13.74	–1.16	0.25
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–832.92	529.09	–1.57	0.12
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	50.97	50.18	1.02	0.31
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	2.01	1.87	1.07	0.28
site.qualitySQ2	–0.1	0.11	–0.91	0.36
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–3.74	2.88	–1.3	0.2
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	3.25	3	1.08	0.28
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	0.38	4.02	0.1	0.92
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–125.04	120.45	–1.04	0.3
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–1.04	3.8	–0.27	0.78
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–0.32	1.82	–0.17	0.86
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	131.86	69.35	1.9	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–62.24	56.89	–1.09	0.27
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	1.78	1.82	0.98	0.33
thinning:initSD.log:yrs.elapsed	0.15	0.1	1.5	0.13

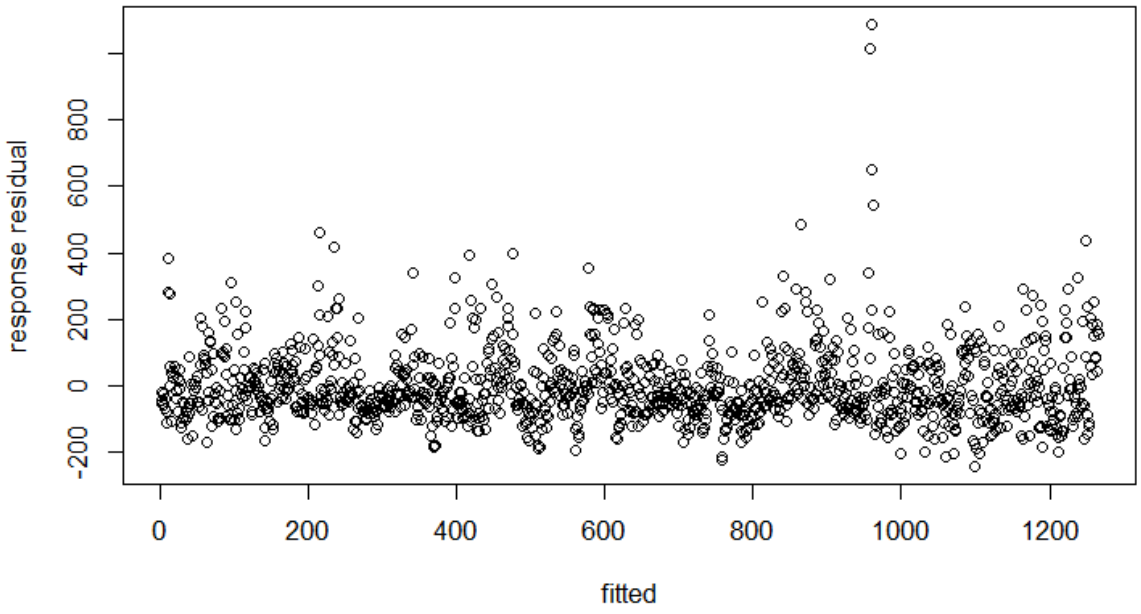

Figure 69 Fitted values and data residuals: bat species Hill-Shannon diversity

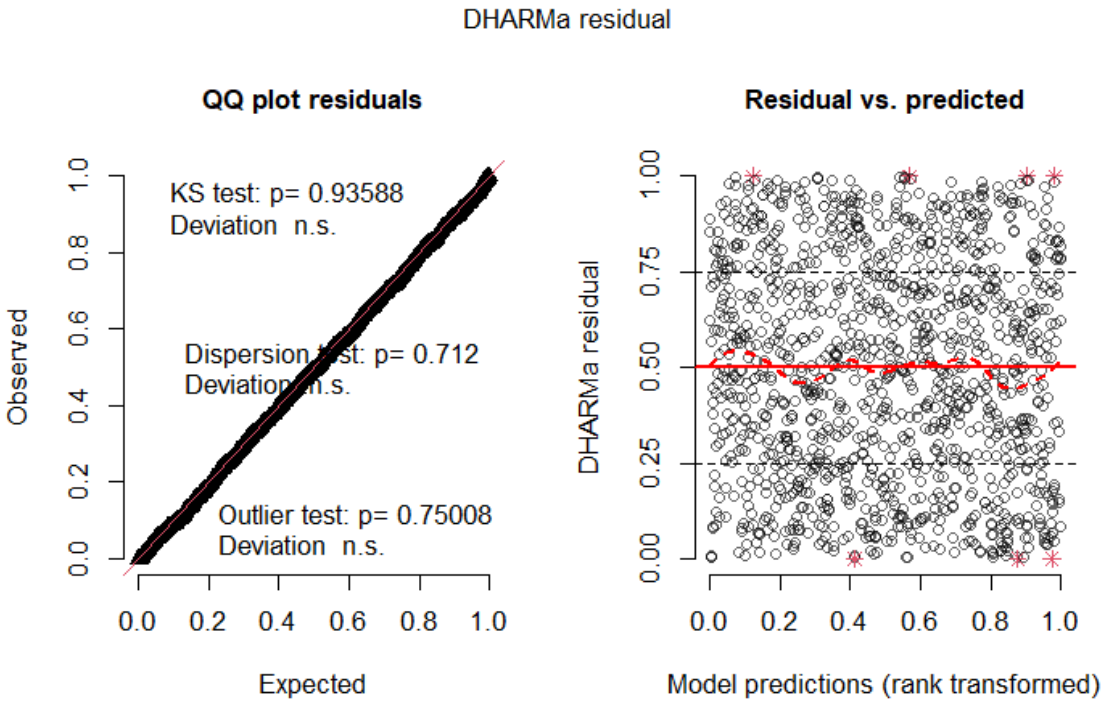

Figure 70 Simulated randomised quantile residuals: bat species Hill-Shannon diversity

15. Bat species list

The number of 9-ha plots the species was recorded in is reported for each survey year (out of 66). In 2021–22, only 41 of the 9-hectare plots were surveyed.

Table 38 Bat species list

Species	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22
Chalinolobus gouldii	62	47	63	61	58	66	41
Chalinolobus morio	41	21	45	47	39	59	32
Mormopterus spp	54	47	66	66	63	66	41
Nyctophilus spp	64	52	66	66	66	66	40
Saccolaimus flaviventris	14	33	39	41	50	50	25
Scotorepens balstoni	52	45	61	59	55	62	38
Scotorepens greyii	12	17	32	2	20	-	-
Tadarida australis	55	42	60	64	66	66	39
Vespadelus darlingtoni	64	48	65	64	65	65	41
Vespadelus regulus HF	62	48	65	62	58	64	39

Species	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22
Vespadelus vulturnus	64	51	66	66	66	66	41

16. Model summaries: Birds

16.1 Bird abundance

Table 39 Model fitting summary: Bird abundance

Response	Number of birds recorded per 20-minute survey per 2-hectare subplot. Four 20 minute surveys were conducted per survey year. Positive integer variable
Response transformation used	None
R package and function	glmmTMB function in glmmTMB package
Distribution used	Negative binomial with linear parameterisation and log link
Outliers removed	None
Reported model formula	4_3way
Random factors	Siteplot (a factor over 66 plots) Year.factor (a factor for each of the 6 survey years)
Other transformations compared	None
Other models attempted	Poisson: • 4_way: Non-positive definite Hessian, failed residuals tests Negative Binomial, linear parameterisation: • 4_way_nosite_noyearfactor: Non-positive definite Hessian • 4_way_yrs.elapsed as fixed no year factor: No warnings, but bootstrapped simulations failed • 3_way: No warnings but failed residuals tests
- **Confidence comments**	High confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (6.5% of 999)

Model summary 33 Bird abundance

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr.z
(Intercept)	2.97	0.33	8.98	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–6.64	11.05	–0.6	0.55
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	0.27	1.45	0.19	0.85

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–2.37	1.82	–1.3	0.19
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	50.31	88.27	0.57	0.57
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	2.33	1.66	1.41	0.16
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–6.08	11.31	–0.54	0.59
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–130.65	385.09	–0.34	0.73
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	78.8	36.12	2.18	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	0.6	1.31	0.46	0.65
site.qualitySQ2	–0.2	0.05	–3.74	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	0.44	2.15	0.2	0.84
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–0.48	2.34	–0.2	0.84
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	2.13	2.38	0.89	0.37
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–70.59	108.46	–0.65	0.52
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–3.58	2.07	–1.73	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–1.49	1.06	–1.4	0.16
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–10.49	43.99	–0.24	0.81
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–75.04	42.15	–1.78	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	–1.45	1.01	–1.43	0.15
thinning:initSD.log:yrs.elapsed	0.04	0.06	0.63	0.53

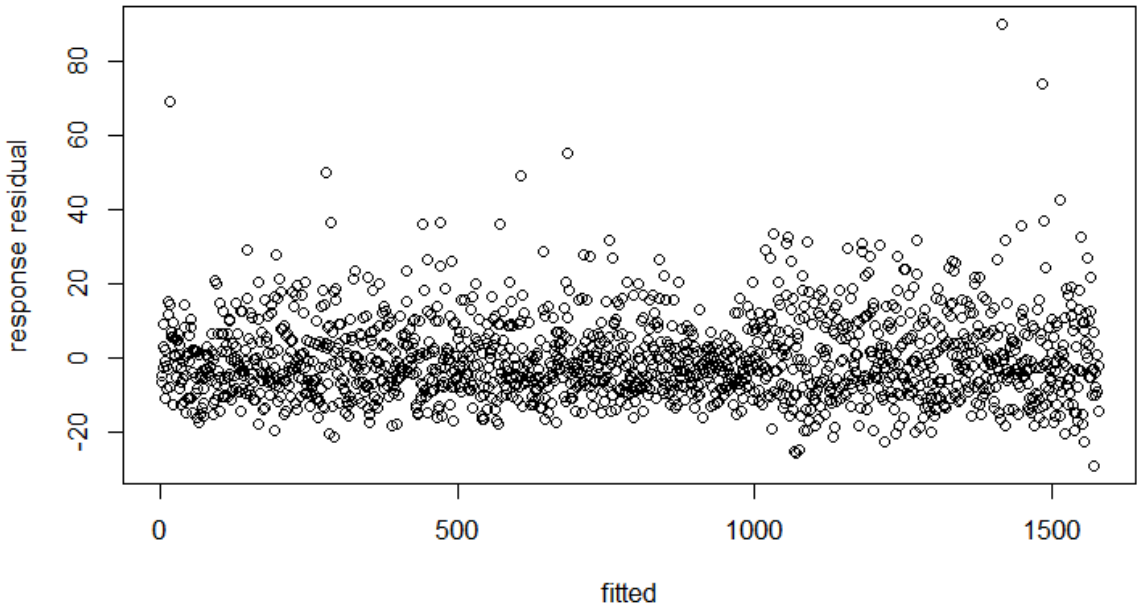

Figure 71 Fitted values and data residuals: bird abundance

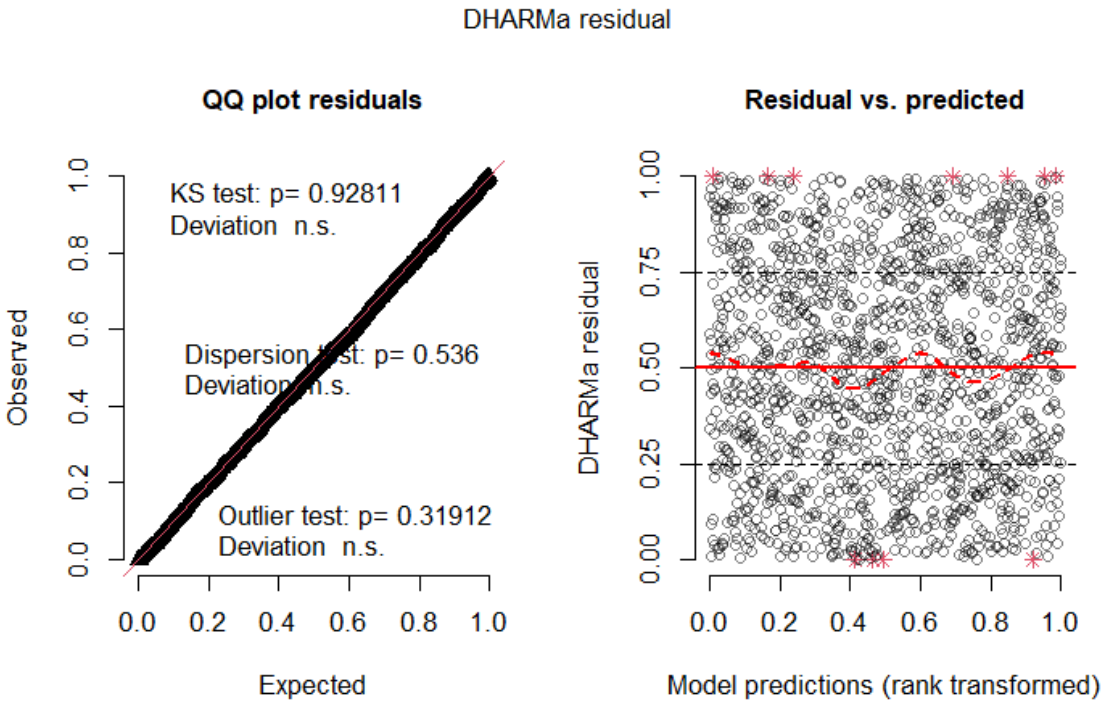

Figure 72 Simulated randomised quantile residuals: bird abundance

16.2 Bird species richness

Table 40 Model fitting summary: Bird species richness

Response	Number of bird species recorded per 20-minute survey per 2-hectare subplot. Four 20 minute surveys were conducted per survey year. Positive integer variable
Response transformation used	None
R package and function	lmer function from the lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model formula	4_way_with no yrs.elapsed and year factor as fixed effect
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots)
Other transformations compared	None
Other models attempted	Gaussian: • 4_way_yrs.elapsed as fixed effect: Model converged but failed all residual tests with pronounced correlation in the residuals over time

	• 4_way_ yrs.elapsed as fixed effect_nosite: Model converged but failed kurtosis-skewness test and pronounced correlation in the residuals over time remained • 4way_ yrs.elapsed as fixed effect_noyearfactor: Model converged and passed all residual tests but AIC higher than the reported model
Confidence comments	Moderate to high confidence • No fit warnings • Passed all residual tests • <10% failure rate in bootstrapped simulations

Model summary 34 Bird species richness

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	10.38	0.67	98.27	15.59	0
poly(cbind(thinning, initSD.log), 2)1.0	47.11	16.78	559.5	2.81	0.01
poly(cbind(thinning, initSD.log), 2)2.0	9.69	13.38	629.97	0.72	0.47
poly(cbind(thinning, initSD.log), 2)0.1	–5.46	25.57	361.55	–0.21	0.83
poly(cbind(thinning, initSD.log), 2)1.1	747.55	839.91	570.73	0.89	0.37
poly(cbind(thinning, initSD.log), 2)0.2	–10.93	16.17	208.47	–0.68	0.5
site.qualitySQ2	–0.46	0.93	92.43	–0.5	0.62
year.factor2017-18	–2.26	0.64	810.33	–3.52	0
year.factor2018-19	–3.44	0.64	810.33	–5.34	0
year.factor2019-20	–2.53	0.64	810.33	–3.93	0
year.factor2020-21	0.21	0.64	810.33	0.33	0.74
year.factor2021-22	–0.3	0.69	942.41	–0.44	0.66
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2	–10.19	21.12	546.75	–0.48	0.63
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2	0.03	21.88	639.6	0	1
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2	26.58	34.21	373.88	0.78	0.44
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2	–297.06	1081.31	571.6	–0.27	0.78
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2	–2.81	20.24	224.11	–0.14	0.89
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2017-18	–22.03	21.14	1454.22	–1.04	0.3
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2017-18	–17.08	16.48	1454.22	–1.04	0.3
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2017-18	–8.59	27.84	1100.23	–0.31	0.76
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2017-18	–1819.45	1053.36	1454.22	–1.73	0.08
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2017-18	27.85	20.08	1500.69	1.39	0.17
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2018-19	–18.03	21.14	1454.22	–0.85	0.39
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2018-19	–11.23	16.48	1454.22	–0.68	0.5
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2018-19	22.57	27.84	1100.23	0.81	0.42
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2018-19	–1673.39	1053.36	1454.22	–1.59	0.11
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2018-19	–0.44	20.08	1500.69	–0.02	0.98
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2019-20	–41.1	21.14	1454.22	–1.94	0.05
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2019-20	–28.65	16.48	1454.22	–1.74	0.08
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2019-20	27.43	27.84	1100.23	0.99	0.32
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2019-20	–1484.06	1053.36	1454.22	–1.41	0.16
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2019-20	0.58	20.08	1500.69	0.03	0.98
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2020-21	–24.38	21.14	1454.22	–1.15	0.25
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2020-21	–29.12	16.48	1454.22	–1.77	0.08

poly(cbind(thinning, initSD.log), 2)0.1:year.factor2020-21	42.51	27.84	1100.23	1.53	0.13
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2020-21	–1585.18	1053.36	1454.22	–1.5	0.13
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2020-21	–1.28	20.08	1500.69	–0.06	0.95
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2021-22	–7.76	27.29	1069.58	–0.28	0.78
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2021-22	38.31	20.08	1500.69	1.91	0.06
site.qualitySQ2:year.factor2017-18	0.11	0.88	902.83	0.13	0.9
site.qualitySQ2:year.factor2018-19	0.09	0.88	902.83	0.1	0.92
site.qualitySQ2:year.factor2019-20	–0.57	0.88	902.83	–0.64	0.52
site.qualitySQ2:year.factor2020-21	0.3	0.88	902.83	0.34	0.73
site.qualitySQ2:year.factor2021-22	–1.74	0.92	982.61	–1.89	0.06
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2017-18	–16.87	26.7	1454.22	–0.63	0.53
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2017-18	25.48	26.72	1454.22	0.95	0.34
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2017-18	–18.13	36.43	1279.48	–0.5	0.62
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2017-18	1168.52	1347.86	1454.22	0.87	0.39
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2017-18	–30.58	25	1499.44	–1.22	0.22
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2018-19	–12.96	26.7	1454.22	–0.49	0.63
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2018-19	30.62	26.72	1454.22	1.15	0.25
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2018-19	–41.72	36.43	1279.48	–1.15	0.25
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2018-19	313.88	1347.86	1454.22	0.23	0.82
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2018-19	24.33	25	1499.44	0.97	0.33
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2019-20	27.66	26.7	1454.22	1.04	0.3
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2019-20	13.68	26.72	1454.22	0.51	0.61
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2019-20	–37.97	36.43	1279.48	–1.04	0.3
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2019-20	1312.24	1347.86	1454.22	0.97	0.33
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2019-20	–1.88	25	1499.44	–0.08	0.94
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2020-21	3.87	26.7	1454.22	0.14	0.88
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2020-21	17.8	26.72	1454.22	0.67	0.51
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2020-21	–43.87	36.43	1279.48	–1.2	0.23
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2020-21	962.64	1347.86	1454.22	0.71	0.48
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2020-21	8.79	25	1499.44	0.35	0.73
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2021-22	10.47	33.32	1172.94	0.31	0.75
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2021-22	–49.7	25	1499.44	–1.99	0.05

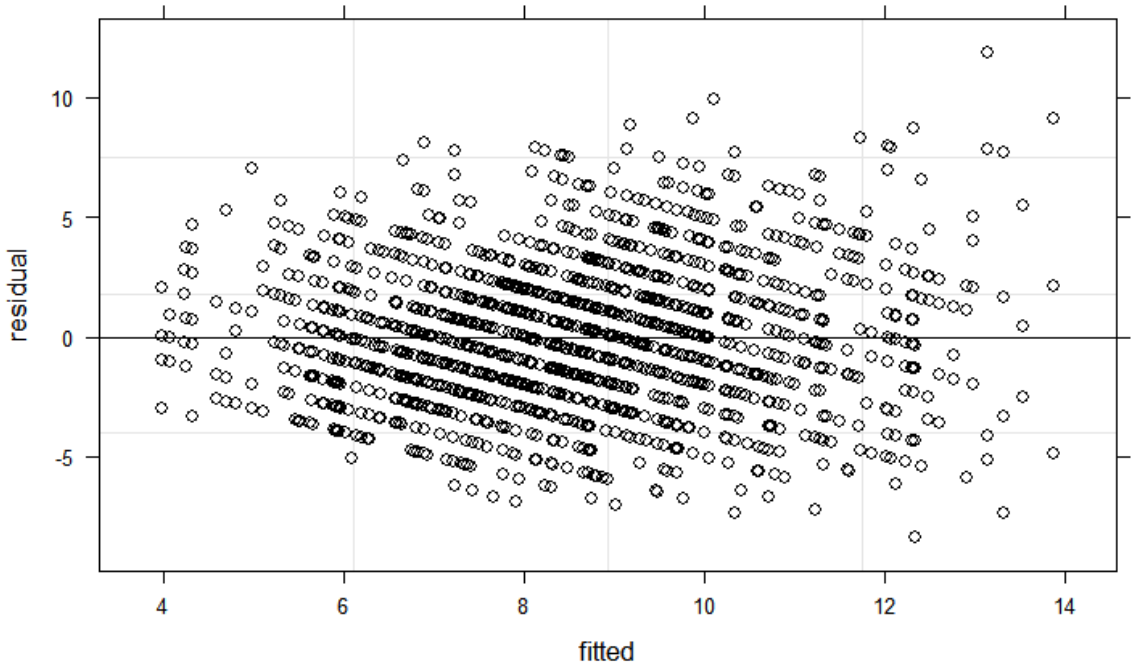

Figure 73 Fitted values and data residuals: bird species richness

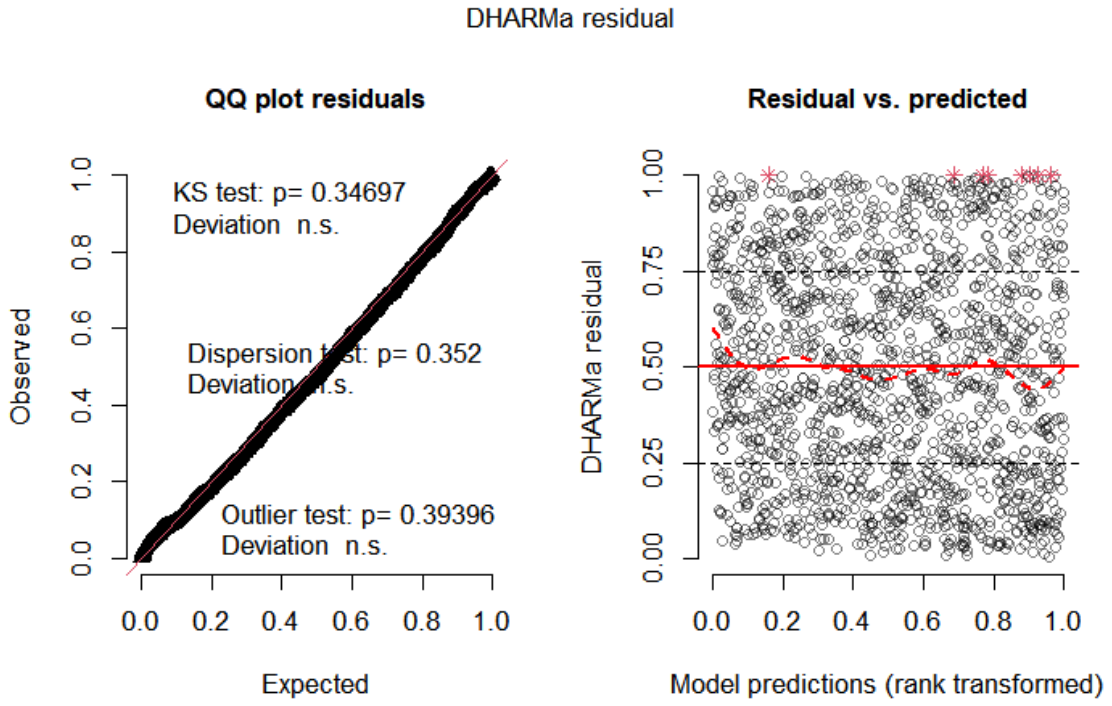

Figure 74 Simulated randomised quantile residuals: bird species richness

16.3 Bird species diversity

Table 41 Model fitting summary: Bird species Hill-Shannon diversity

Response	Hill-Shannon diversity calculated from observed abundance of species per visit. Four 20-minute visits per 2-hectare subplot per survey year. Positive continuous variable
Response transformation used	None
R package and function	lmer function in lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model formula	4_way with no years elapsed and year factor as a fixed effect
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots)
Other transformations compared	None
Other models attempted	Gaussian: • 4_way: Model converged, but the residuals showed strong correlation between year.factor and years.elapsed • 4_way without year.factor as random effect: Model converged and suitable residuals, however, the AICc was higher for this model than the reported model
Confidence comments	Moderate to high confidence: • No fit warnings • Slight fanning in the raw fitted versus residuals plot, but DHARMa simulated quantile residual dispersion test was not significant • Passed all residual tests • <1% non-convergence or boundary fit warnings out of 999 bootstrapped simulations for confidence interval calculations

Model summary 35 Bird species Hill-Shannon diversity

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	8.21	0.54	105	15.25	0
poly(cbind(thinning, initSD.log), 2)1.0	33.69	13.65	578.13	2.47	0.01
poly(cbind(thinning, initSD.log), 2)2.0	11.56	10.89	640.29	1.06	0.29
poly(cbind(thinning, initSD.log), 2)0.1	–4.82	20.73	391.77	–0.23	0.82
poly(cbind(thinning, initSD.log), 2)1.1	298.73	683.31	588.01	0.44	0.66
poly(cbind(thinning, initSD.log), 2)0.2	–7.34	13.05	234.34	–0.56	0.57
site.qualitySQ2	0.06	0.75	98.81	0.09	0.93
year.factor2017-18	–1.65	0.52	834.92	–3.15	0
year.factor2018-19	–2.47	0.52	834.92	–4.7	0
year.factor2019-20	–1.69	0.52	834.92	–3.23	0

year.factor2020-21	0.84	0.52	834.92	1.6	0.11
year.factor2021-22	0.13	0.57	967.47	0.24	0.81
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2	–3.82	17.18	567.04	–0.22	0.82
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2	–3.25	17.81	647.39	–0.18	0.86
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2	17.53	27.74	400.14	0.63	0.53
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2	50.81	879.6	587.71	0.06	0.95
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2	–3.32	16.35	252.36	–0.2	0.84
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2017-18	–8.31	17.36	1455.66	–0.48	0.63
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2017-18	–15.8	13.53	1455.66	–1.17	0.24
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2017-18	–6.5	22.75	1118.37	–0.29	0.78
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2017-18	–1537.47	864.94	1455.66	–1.78	0.08
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2017-18	19.19	16.47	1500.75	1.16	0.24
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2018-19	–14.17	17.36	1455.66	–0.82	0.41
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2018-19	–9.03	13.53	1455.66	–0.67	0.5
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2018-19	10.51	22.75	1118.37	0.46	0.64
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2018-19	–794.85	864.94	1455.66	–0.92	0.36
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2018-19	3.91	16.47	1500.75	0.24	0.81
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2019-20	–24.65	17.36	1455.66	–1.42	0.16
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2019-20	–29.59	13.53	1455.66	–2.19	0.03
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2019-20	21.75	22.75	1118.37	0.96	0.34
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2019-20	–1047.74	864.94	1455.66	–1.21	0.23
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2019-20	1.25	16.47	1500.75	0.08	0.94
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2020-21	–20.99	17.36	1455.66	–1.21	0.23
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2020-21	–28.21	13.53	1455.66	–2.08	0.04
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2020-21	30.06	22.75	1118.37	1.32	0.19
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2020-21	–865.76	864.94	1455.66	–1	0.32
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2020-21	3.32	16.47	1500.75	0.2	0.84
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2021-22	–14.83	22.29	1088.15	–0.67	0.51
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2021-22	34.35	16.47	1500.75	2.09	0.04
site.qualitySQ2:year.factor2017-18	–0.16	0.72	930.44	–0.22	0.82
site.qualitySQ2:year.factor2018-19	–0.49	0.72	930.44	–0.69	0.49
site.qualitySQ2:year.factor2019-20	–0.79	0.72	930.44	–1.1	0.27
site.qualitySQ2:year.factor2020-21	–0.27	0.72	930.44	–0.38	0.71
site.qualitySQ2:year.factor2021-22	–2	0.75	1009.78	–2.65	0.01
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2017-18	–21.37	21.92	1455.66	–0.97	0.33
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2017-18	24.83	21.94	1455.66	1.13	0.26
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2017-18	–7.99	29.8	1293.1	–0.27	0.79
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2017-18	949.54	1106.77	1455.66	0.86	0.39
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2017-18	–20.39	20.5	1499.55	–0.99	0.32
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2018-19	–15.03	21.92	1455.66	–0.69	0.49
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2018-19	31.65	21.94	1455.66	1.44	0.15
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2018-19	–30.53	29.8	1293.1	–1.02	0.31
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2018-19	–571.02	1106.77	1455.66	–0.52	0.61
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2018-19	13.4	20.5	1499.55	0.65	0.51

poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2019-20	16.73	21.92	1455.66	0.76	0.45
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2019-20	18.5	21.94	1455.66	0.84	0.4
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2019-20	–23.81	29.8	1293.1	–0.8	0.42
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2019-20	898.26	1106.77	1455.66	0.81	0.42
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2019-20	–1.64	20.5	1499.55	–0.08	0.94
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2020-21	6.14	21.92	1455.66	0.28	0.78
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2020-21	12.46	21.94	1455.66	0.57	0.57
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2020-21	–23.74	29.8	1293.1	–0.8	0.43
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2020-21	701.86	1106.77	1455.66	0.63	0.53
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2020-21	0.4	20.5	1499.55	0.02	0.98
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2021-22	20.52	27.24	1189.83	0.75	0.45
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2021-22	–44.93	20.5	1499.55	–2.19	0.03

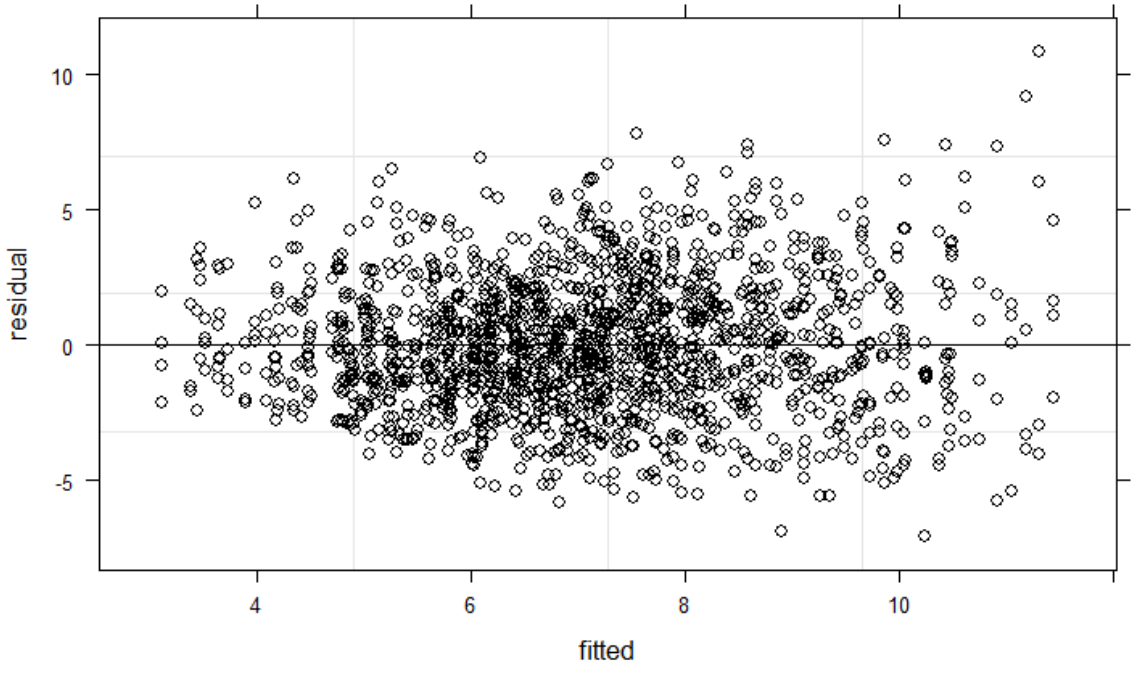

Figure 75 Fitted values and data residuals: bird species Hill-Shannon diversity

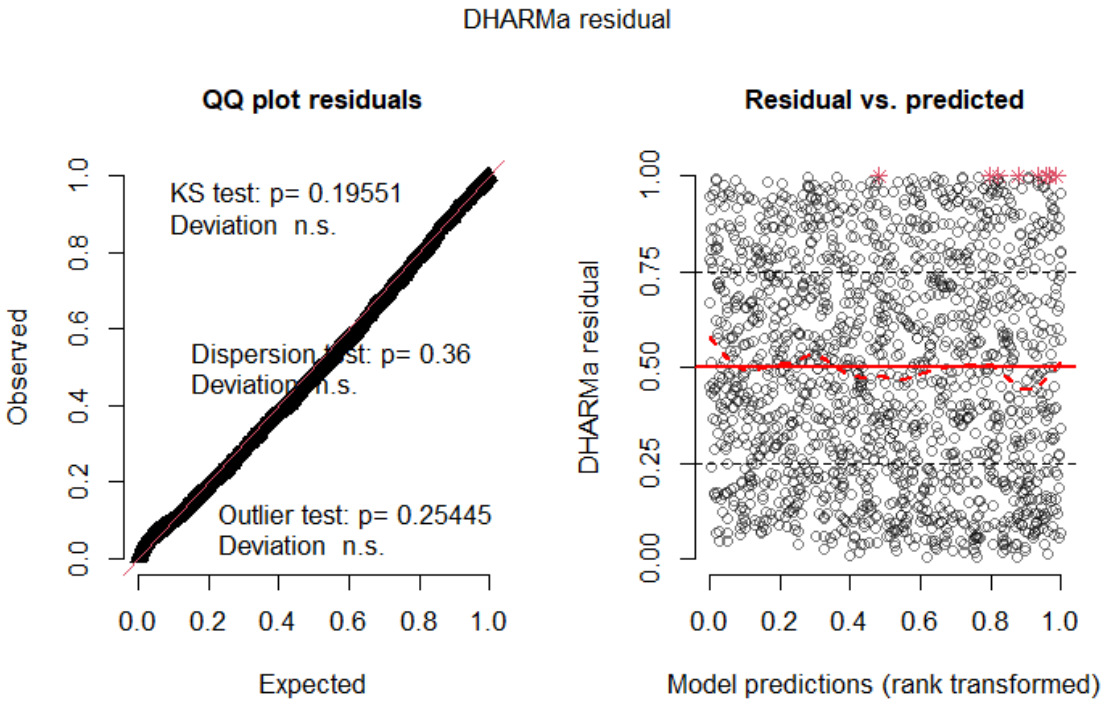

Figure 76 Simulated randomised quantile residuals: bird species Hill-Shannon diversity

17. Bird species list

The number of 9-hectare plots the species was recorded in is reported for each survey year (out of 66).

Table 42 Bird species list

Species name	2015–16	2017–18	2018–19	2019–20	2020–21	2021–22
Australian hobby	1	-	-	2	-	-
Australian magpie	24	31	33	29	41	46
Australian raven	19	23	10	14	28	13
Australian reed warbler	1	3	-	6	-	-
Australian shelduck	1	-	-	-	1	-
Australian white ibis	5	1	-	-	-	2
Australian wood duck	-	2	-	-	2	3
Azure Kingfisher	-	1	-	-	-	-
Black-chinned honeyeater	1	-	-	1	-	-
Black-faced cuckoo-shrike	42	26	33	35	42	31
Blue-faced honeyeater	2	1	-	1	2	1
Brahminy kite	-	-	1	-	-	-
Brown-headed honeyeater	7	10	8	16	22	15

Brown falcon	-	1	-	-	-	1
Brown goshawk	1	2	2	1	4	1
Brown quail	-	-	-	-	-	1
Brown songlark	-	-	-	1	-	-
Brown thornbill	1	2	1	1	-	1
Brown treecreeper	32	42	37	38	33	25
Buff-rumped thornbill	60	59	59	62	59	59
Collared sparrowhawk	-	2	-	-	8	1
Common bronzewing	4	7	7	4	9	8
Crested shrike-tit	5	7	4	2	9	4
Dollarbird	1	1	1	4	1	1
Dusky woodswallow	9	7	9	12	8	9
Eastern great egret	1	-	-	-	-	-
Eastern rosella	2	5	3	4	2	7
Emu	5	3	3	-	2	3
Fan-tailed cuckoo	12	4	-	2	4	-
Flame robin	-	-	-	-	1	-
Fork-tailed swift	-	-	1	-	-	-
Galah	43	43	41	35	55	34
Golden whistler	1	2	-	2	1	-
Great egret	2	-	-	-	-	-
Grey-crowned babbler	-	1	-	-	-	-
Grey butcherbird	-	-	2	-	-	-
Grey fantail	51	43	36	36	41	43
Grey shrike-thrush	59	50	48	40	59	50
Grey teal	1	-	-	1	-	5
Hooded robin	1	2	-	2	1	1
Horsfields bronze-cuckoo	7	7	2	4	1	-
Intermediate egret	2	-	-	-	-	-
Jacky winter	14	23	26	26	24	22
Laughing kookaburra	26	30	22	21	26	25
Leaden flycatcher	3	2	-	1	3	4
Little eagle	1	1	-	-	1	1
Little friarbird	7	8	5	10	6	4
Little grassbird	1	1	-	-	-	-
Little pied cormorant	-	-	-	-	-	1
Little raven	3	2	3	3	-	-
Long-billed corella	7	18	11	10	21	4

Magpie-lark	2	2	-	-	1	4
Masked woodswallow	-	-	-	-	1	-
Mistletoebird	36	21	23	31	19	38
Nankeen night heron	1	-	1	-	1	6
Noisy friarbird	34	25	25	35	42	40
Olive-backed oriole	1	-	-	2	7	1
Pacific black duck	3	7	2	2	5	4
Painted button-quail	3	1	-	-	-	11
Painted honeyeater	-	-	1	1	-	-
Pallid cuckoo	-	1	1	-	3	-
Peaceful dove	12	6	15	2	11	13
Peregrine falcon	2	3	3	1	1	2
Pied butcherbird	2	3	-	1	3	3
Pied currawong	-	-	-	-	1	-
Quail species	1	-	-	-	-	-
Rainbow bee-eater	4	6	5	5	6	4
Red-browed finch	-	-	-	-	1	4
Red-capped robin	16	10	2	6	3	1
Red-rumped parrot	3	6	2	3	9	8
Red wattlebird	2	-	-	-	-	1
Restless flycatcher	1	3	-	-	3	1
Royal spoonbill	2	-	-	-	-	-
Rufous fantail	-	1	-	-	-	-
Rufous songlark	4	1	-	4	-	-
Rufous whistler	55	37	37	49	58	43
Sacred kingfisher	46	37	39	39	47	38
Satin flycatcher	-	1	-	-	-	-
Scarlet robin	29	22	29	19	18	29
Shining bronze-cuckoo	6	5	1	-	22	-
Silvereye	25	14	11	9	25	19
Southern boobook	1	-	-	-	-	-
Spotted pardalote	18	26	10	40	21	16
Square-tailed kite	-	-	-	-	2	-
Straw-necked ibis	-	-	-	-	-	2
Striated pardalote	64	62	60	62	64	65
Striated thornbill	33	27	38	33	52	47
Sulphur-crested cockatoo	50	56	54	51	59	42
Superb fairy-wren	41	48	52	36	37	43

Superb parrot	3	1	2	3	7	-
Swamp harrier	-	-	-	1	3	-
Swift parrot	-	-	-	-	1	-
Tree martin	2	4	2	-	1	4
Varied sittella	5	4	11	11	13	15
Wedge-tailed eagle	8	4	7	7	8	3
Weebill	54	53	53	56	57	48
Welcome swallow	3	5	2	-	2	3
Western gerygone	22	11	4	3	22	8
Whistling kite	5	4	6	5	4	4
White-bellied sea-eagle	2	-	2	1	-	-
White-breasted woodswallow	3	1	3	1	1	2
White-browed babbler	1	1	1	2	-	-
White-browed scrubwren	5	7	7	8	6	11
White-browed woodswallow	-	-	4	9	3	-
White-faced heron	2	2	2	2	4	9
White-necked heron	1	1	-	2	-	3
White-plumed honeyeater	35	45	42	43	20	16
White-throated needletail	-	-	-	-	-	1
White-throated treecreeper	64	63	62	54	56	64
White-winged chough	22	11	8	13	10	7
White-winged triller	1	7	3	12	4	-
Willie wagtail	6	7	8	5	8	5
Yellow-rumped thornbill	7	11	3	5	10	6
Yellow rosella	51	52	42	38	54	57
Yellow thornbill	13	20	38	39	51	50

18. Model summaries: Gliders

18.1 Count of glider feed trees

Table 43 Model fitting summary: Count of glider feed trees

Response	Number of glider feed trees per 9-hectare plot Positive integer variable
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Poisson
Outliers removed	None
Reported model formula	4_3way
Random factors	Siteplot (a factor over 66 plots)
Other transformations compared	None
Other models attempted	Poisson • 4_way: Non-positive definite Hessian • 4_way with no random effects for site or year: Non-positive definite Hessian • 3_3way: Non-positive definite Hessian • 3_3way with no random effects for site: Non-positive definite Hessian • 3_3way with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but bootstrapped simulations failed • 3_3way with no random effects for year: No warnings, but bootstrapped simulations failed • 3_3way with no random effects for site and with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but bootstrapped simulations failed
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (4.5% of 999) • Wide confidence intervals for some treatment groups

Model summary 36 Count of glider feed trees

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	–4.03	5.06	–0.80	0.43
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–28.68	48.86	–0.59	0.56
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	5.82	2.76	2.11	0.04

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–12.12	5.31	–2.28	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–35.78	43.50	–0.82	0.41
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	1.51	2.81	0.54	0.59
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–34.66	33.81	–1.03	0.31
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–169.19	325.98	–0.52	0.60
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–98.30	47.37	–2.08	0.04
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–2.09	2.68	–0.78	0.43
site.qualitySQ2	0.68	0.41	1.66	0.10
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–3.59	4.25	–0.85	0.40
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–3.17	3.69	–0.86	0.39
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	12.76	4.78	2.67	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	17.25	46.82	0.37	0.71
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–2.69	3.34	–0.80	0.42
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	1.24	4.49	0.28	0.78
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–63.98	38.28	–1.67	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	127.87	47.97	2.67	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	1.71	3.47	0.49	0.62
thinning:initSD.log:yrs.elapsed	0.40	0.65	0.62	0.54

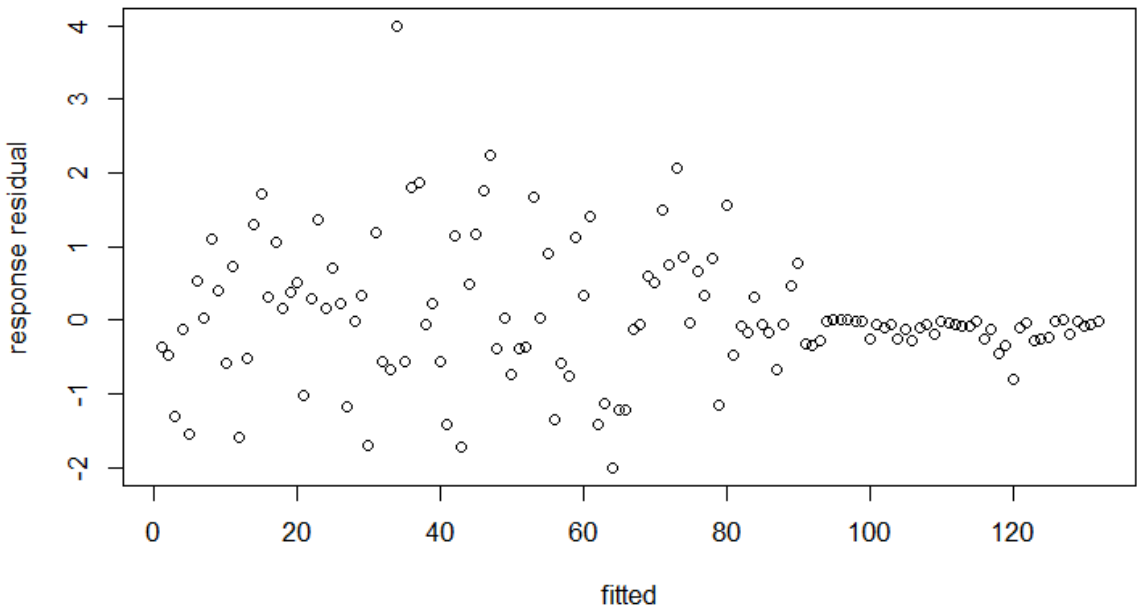

Figure 77 Fitted values and data residuals: count of glider feed trees

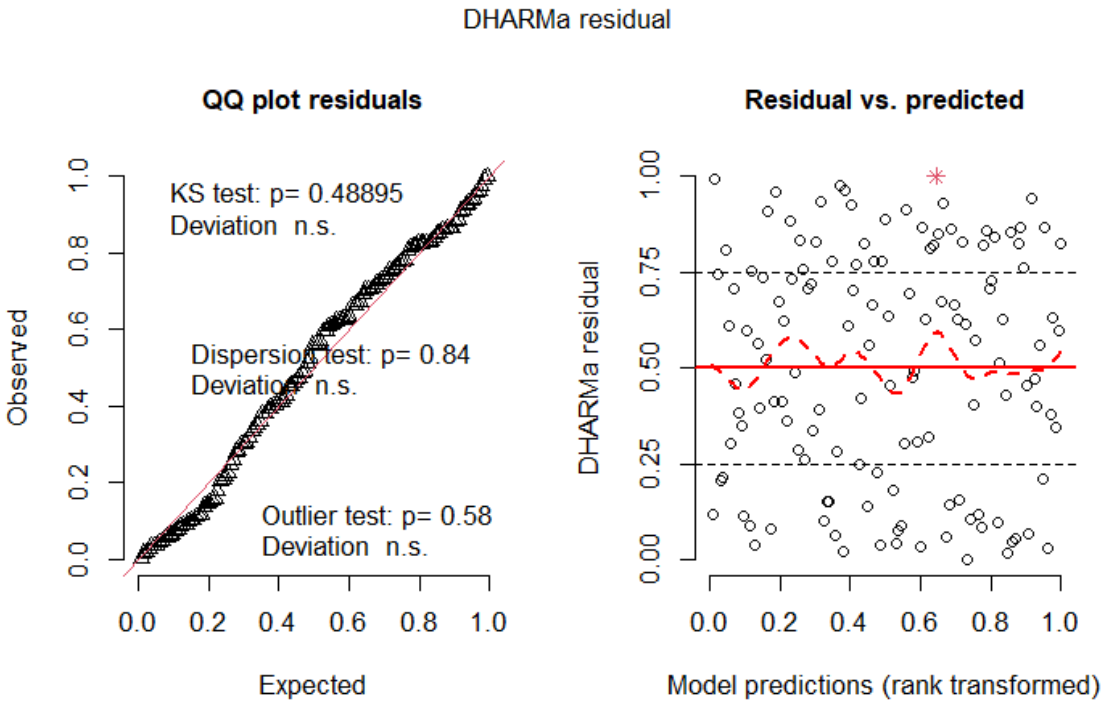

Figure 78 Simulated randomised quantile residuals: count of glider feed trees

19. Model summaries: Floristics

19.1 Exotic plant diversity

Table 44 Model fitting summary: exotic plant diversity

Response	Hill-Shannon diversity calculated for exotic plants per 10 1m x 1m quadrats within each 0.04-hectare floristic plot Positive continuous variable
Response transformation used	Hill-Shannon index ascribes a value of 1 to the presence of both zero and one species. However, no exotic species detected during a survey is ecologically different to sites where one species was detected. Across all six survey years, 236 surveyed subplots had zero exotic species recorded. We transformed these to a Hill-Shannon value of '0'. For analysis, all values were rounded to the nearest whole number.
R package and function	glmmTMB function in the glmmTMB package
Distribution used	Poisson distribution
Outliers removed	None
Reported model formula	4_3way
Random factors	Siteplot Subplot (floristic 0.04-hectare subplots)

Other transformations compared	Yes – Beta models attempted after normalising response variable between 0 and 1
Other models attempted	Gamma: • 4_way: Model failed to converge • 4_way_no year factor: Model failed to converge • 3_way_no year factor: Model failed to converge • 4_way_noyrselapsed: Model failed to converge • 3_way_noyrselapsed: Model failed to converge Beta with normalised response variable between 0 and 1: • 4_way: Model failed to converge • 4_way_no year factor: Model failed to converge Truncated Poisson: • 4_way: Model failed to converge but the model fit has improved • 4_way_no year factor: Model failed to converge • 3_way: Model converged but bootstrap simulations failed • 3_way_no yrs.elapsed: Model failed to converge
Confidence comments	Moderate to high confidence: • No convergence or fit warnings • Minor deviation from expected in Kurtosis-Skewness test • 6 model warnings out of 999 bootstrapped simulations for confidence interval calculations

Model summary 37 Exotic plant diversity

	Estimate	Std.Error	z.value	Pr...z..
(Intercept)	–0.39334	0.510946	–0.76983	0.441401
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	–32.0922	18.2855	–1.75506	0.079249
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	0.476199	2.141902	0.222325	0.824061
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	2.633359	4.034693	0.652679	0.513963
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–8.87483	107.1556	–0.08282	0.933993
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	1.003446	4.042915	0.248199	0.803981
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–27.3634	15.09282	–1.81301	0.06983
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–1014.39	545.9616	–1.85798	0.063171
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–112.337	58.26468	–1.92804	0.05385
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–1.70524	1.274884	–1.33757	0.181037
site.qualitySQ2	0.163265	0.145618	1.121184	0.26221
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	6.009484	3.60512	1.666931	0.095528
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	6.201925	3.727961	1.663624	0.096188
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–7.92657	5.171008	–1.53289	0.125304
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–238.366	142.8181	–1.66902	0.095114
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	4.520633	4.898307	0.922897	0.356061
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–0.20804	2.027292	–0.10262	0.918264
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–110.185	66.90851	–1.6468	0.099599
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	97.35436	63.22794	1.539736	0.123625
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	5.911157	1.797285	3.288936	0.001006
thinning:initSD.log:yrs.elapsed	0.217108	0.112048	1.937636	0.052668

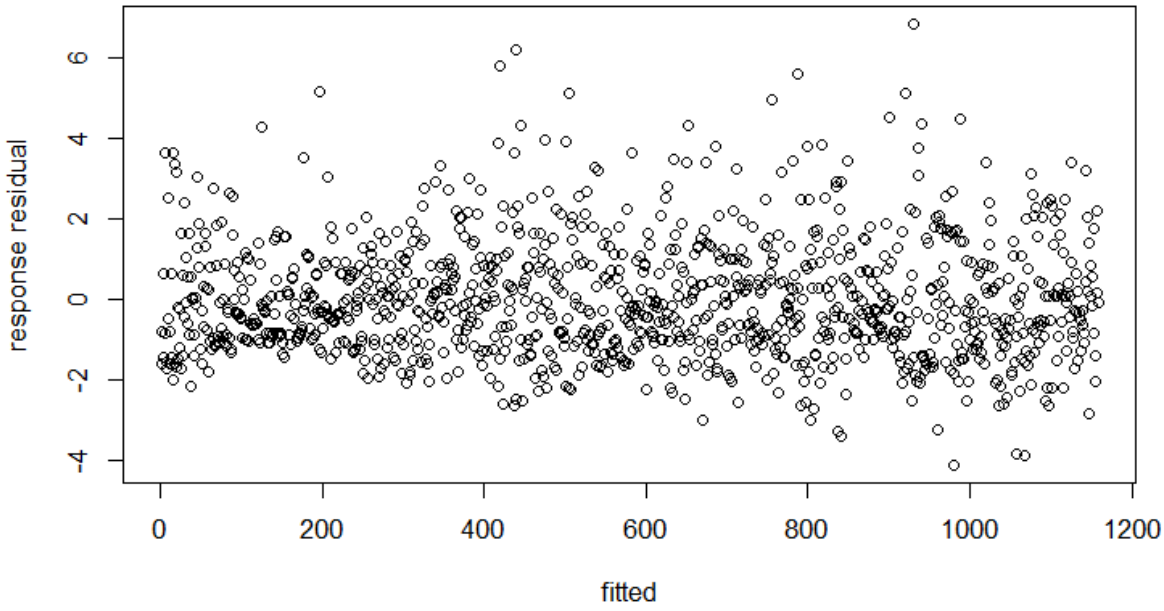

Figure 79 Fitted values and data residuals: exotic plant diversity

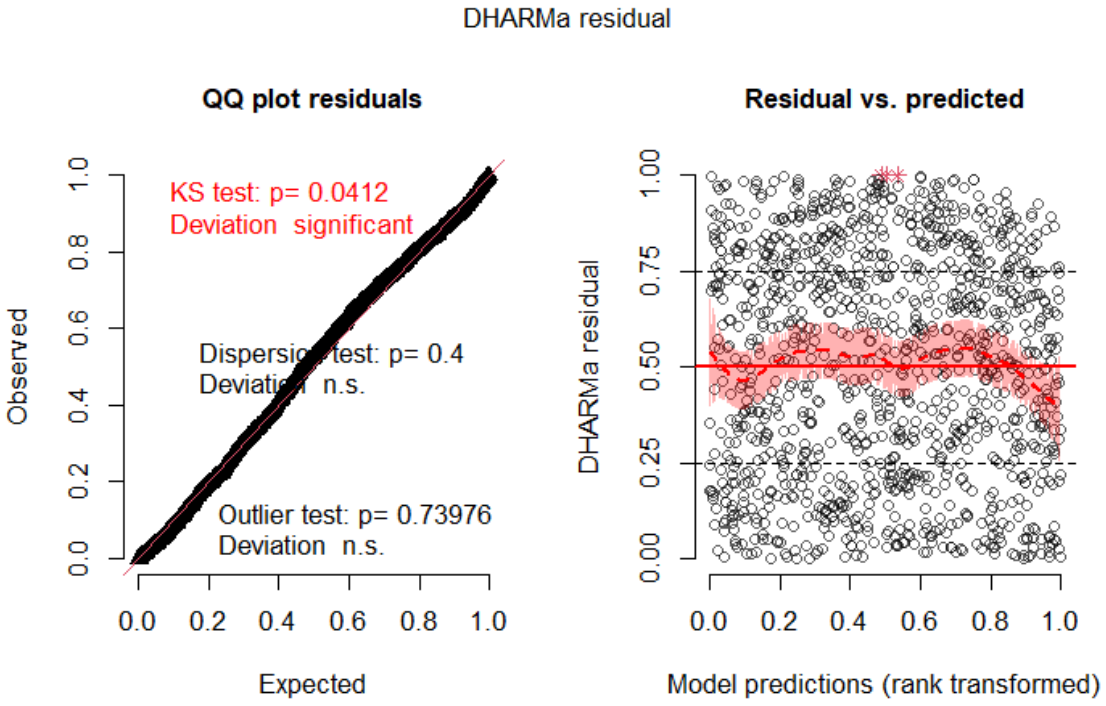

Figure 80 Simulated randomised quantile residuals: exotic plant diversity

19.2 Exotic plant species richness

Table 45 Model fitting summary: exotic plant species richness

Response	Number of exotic plant species recorded in each 0.04 each subplot Positive integer variable
Response transformation used	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model formula	4way with no years.elapsed and year.factor as fixed effect
Random factors	Site (a factor over 22 sites) Siteplot (a factor over 66 plots) 0.04 ha subplot (a factor over 198 subplots)
Other transformations compared	None
Other models attempted	Gaussian • 4way: Non-positive definite Hessian and failed residual tests • 4way with no random effects for site and no years.elapsed and year.factor as fixed effect: No improvement over reported model Poisson • 4way with no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian • 4way with no random effects for site and no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian • 3_3way with no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian • 3_3way with no random effects for site and no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian Negative Binomial, linear parameterisation • 4way with no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian • 4way with no random effects for site and no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian • 3_3way with no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian • 3_3way with no random effects for site and no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian Negative Binomial, quadratic parameterisation • 4way with no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian • 4way with no random effects for site and no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian • 3_3way with no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian • 3_3way with no random effects for site and no years.elapsed and year.factor as fixed effect: Non-positive definite Hessian

Confidence comments	Moderate to high confidence: • No convergence or fit warnings • Minor deviation from expected in Kurtosis-Skewness test • 0.9% non-convergence or boundary fit warnings out of 999 bootstrapped simulations for confidence interval calculations

Model summary 38 Exotic plant species richness

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	5.92	1.09	52.67	5.46	0.00
poly(cbind(thinning, initSD.log), 2)1.0	9.64	19.79	709.59	0.49	0.63
poly(cbind(thinning, initSD.log), 2)2.0	1.51	14.43	721.11	0.10	0.92
poly(cbind(thinning, initSD.log), 2)0.1	24.11	31.66	335.86	0.76	0.45
poly(cbind(thinning, initSD.log), 2)1.1	219.95	912.29	788.39	0.24	0.81
poly(cbind(thinning, initSD.log), 2)0.2	–27.33	19.04	104.30	–1.43	0.15
site.qualitySQ2	–0.17	1.49	47.33	–0.12	0.91
year.factor2017	0.38	0.82	782.78	0.46	0.64
year.factor2018	–0.57	0.82	782.78	–0.70	0.49
year.factor2019	1.34	0.82	782.78	1.64	0.10
year.factor2020	4.95	0.82	782.78	6.05	0.00
year.factor2021	0.24	1.17	933.04	0.21	0.83
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2	6.10	23.99	667.85	0.25	0.80
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2	6.75	23.50	742.62	0.29	0.77
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2	–3.30	40.59	304.71	–0.08	0.94
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2	88.87	1107.10	758.18	0.08	0.94
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2	21.35	23.35	104.09	0.91	0.36
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2017	36.63	22.25	914.89	1.65	0.10
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2017	18.57	16.18	907.61	1.15	0.25
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2017	–25.34	31.48	908.05	–0.81	0.42
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2017	–556.55	1006.98	919.27	–0.55	0.58
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2017	31.42	19.24	937.61	1.63	0.10
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2018	8.69	22.25	914.89	0.39	0.70
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2018	–17.94	16.18	907.61	–1.11	0.27
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2018	–7.59	31.48	908.05	–0.24	0.81
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2018	–768.23	1006.98	919.27	–0.76	0.45
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2018	15.27	19.24	937.61	0.79	0.43
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2019	8.87	22.25	914.89	0.40	0.69
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2019	3.21	16.18	907.61	0.20	0.84
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2019	–22.41	31.48	908.05	–0.71	0.48
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2019	301.81	1006.98	919.27	0.30	0.76
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2019	48.29	19.24	937.61	2.51	0.01
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2020	4.55	22.25	914.89	0.20	0.84
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2020	48.61	16.18	907.61	3.00	0.00
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2020	–85.54	31.48	908.05	–2.72	0.01
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2020	2232.43	1006.98	919.27	2.22	0.03
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2020	75.53	19.24	937.61	3.93	0.00
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2021	–42.25	45.29	952.87	–0.93	0.35
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2021	22.40	35.20	944.02	0.64	0.52
site.qualitySQ2:year.factor2017	2.27	1.08	793.37	2.10	0.04

site.qualitySQ2:year.factor2018	0.40	1.08	793.37	0.37	0.71
site.qualitySQ2:year.factor2019	–1.15	1.08	793.37	–1.07	0.29
site.qualitySQ2:year.factor2020	–0.43	1.08	793.37	–0.39	0.69
site.qualitySQ2:year.factor2021	2.59	1.37	909.24	1.89	0.06
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2017	–0.79	27.26	912.13	–0.03	0.98
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2017	–12.19	26.21	910.37	–0.47	0.64
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2017	–9.51	38.90	933.70	–0.24	0.81
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2017	448.13	1231.02	916.67	0.36	0.72
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2017	–15.83	23.64	937.28	–0.67	0.50
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2018	23.30	27.26	912.13	0.85	0.39
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2018	20.56	26.21	910.37	0.78	0.43
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2018	–27.23	38.90	933.70	–0.70	0.48
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2018	461.85	1231.02	916.67	0.38	0.71
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2018	–13.52	23.64	937.28	–0.57	0.57
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2019	3.28	27.26	912.13	0.12	0.90
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2019	16.96	26.21	910.37	0.65	0.52
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2019	–16.98	38.90	933.70	–0.44	0.66
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2019	–1122.44	1231.02	916.67	–0.91	0.36
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2019	–32.41	23.64	937.28	–1.37	0.17
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2020	15.43	27.26	912.13	0.57	0.57
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2020	–21.98	26.21	910.37	–0.84	0.40
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2020	71.16	38.90	933.70	1.83	0.07
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2020	–2731.34	1231.02	916.67	–2.22	0.03
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2020	–50.47	23.64	937.28	–2.14	0.03
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2021	22.96	48.98	951.94	0.47	0.64
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2021	3.36	37.82	943.32	0.09	0.93

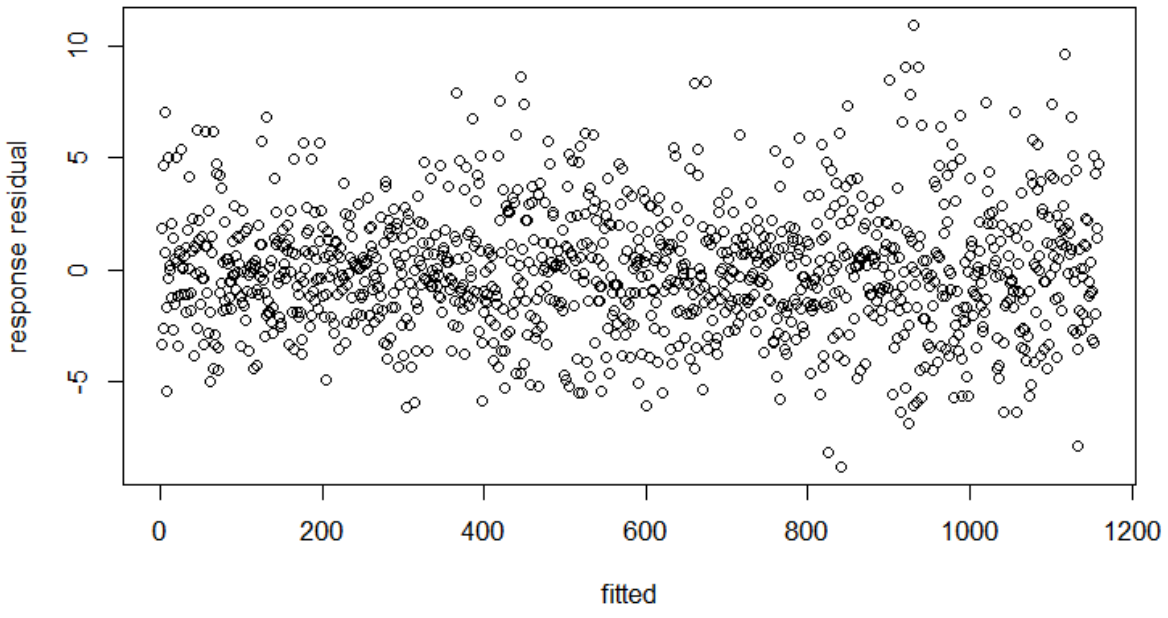

Figure 81 Fitted values and data residuals: exotic plant species richness

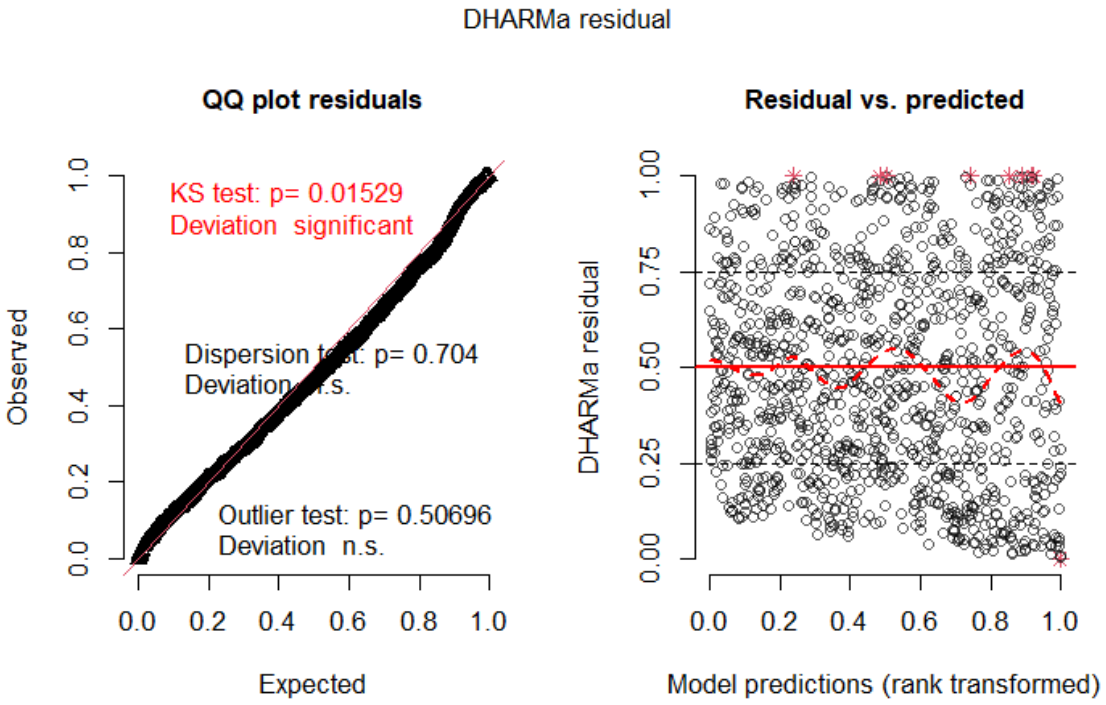

Figure 82 Simulated randomised quantile residuals: exotic plant species richness

19.3 Exotic plant cover

Table 46 Model fitting summary: exotic plant cover

Response	Percentage of 0.04-hectare subplot that was exotic vegetation Positive continuous bounded variable Modelled as the ratio of exotic plant cover to not exotic plant cover
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Binomial
Outliers removed	None
Model reported	3_3way
Random factors	Siteplot (a factor over 66 plots) Subplot (a factor over 198 subplots)
Other transformations compared	Proportion (Beta models)
Other models attempted	Beta - 4_way: Non-positive definite Hessian, failed residuals tests - 3_3way with no random effects for site, siteplot, year factor: No warnings, but failed residual tests

	- 3_3way with no random effects for site or siteplot and with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but failed residual tests Binomial - 4_way: Non-positive definite Hessian, failed residuals tests - 4_way with no random effects for survey year: Non-positive definite Hessian - 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but bootstrapped simulations failed - 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor and no random effects for site: No warnings, but bootstrapped simulations failed - 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor and no random effects for site or siteplot: No warnings, but bootstrapped simulations failed - 3_3way with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but bootstrapped simulations failed - 3_3way with yrs.elapsed removed and year factor changed from random factor to fixed factor and no random effects for site: No warnings, but bootstrapped simulations failed - 3_3way with yrs.elapsed removed and year factor changed from random factor to fixed factor and no random effects for site or siteplot: No warnings, but bootstrapped simulations failed - 2way: No warnings, but failed residual tests
Confidence comments	Moderate to high confidence: • No fit warnings • Conformed to all residual tests • Some non-convergence warnings in bootstrapped prediction interval simulations (<5% of 999)

Model summary 39 Exotic plant cover

	cond.Estimate	cond.Std.Error	cond.z.value	cond.Pr...z..
(Intercept)	–8.62158	0.605799	–14.2317	5.82E-46
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	28.59447	14.68655	1.946984	0.051537
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–2.53475	11.68915	–0.21685	0.828328
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	–0.0679	14.01	–0.00485	0.996133
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	–550.175	424.249	–1.29682	0.194693
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–16.1018	15.53305	–1.03662	0.299915
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	–50.9269	3.931657	–12.953	2.26E-38
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	–362.214	68.74671	–5.26883	1.37E-07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	–699.109	97.13146	–7.19756	6.13E-13
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–63.4545	3.69481	–17.174	4.16E-66
site.qualitySQ2	0.60987	0.811188	0.751823	0.452158
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–14.1747	18.84938	–0.752	0.452051
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–10.8112	20.02329	–0.53993	0.589245
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–11.767	20.44943	–0.57542	0.565006
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	976.6383	555.1716	1.759165	0.07855

poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	24.19944	18.66317	1.296642	0.194755
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	39.10505	5.90297	6.624639	3.48E-11
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	349.4361	103.5551	3.374397	0.00074
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	443.065	132.6539	3.340007	0.000838
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	34.84924	4.713406	7.393643	1.43E-13

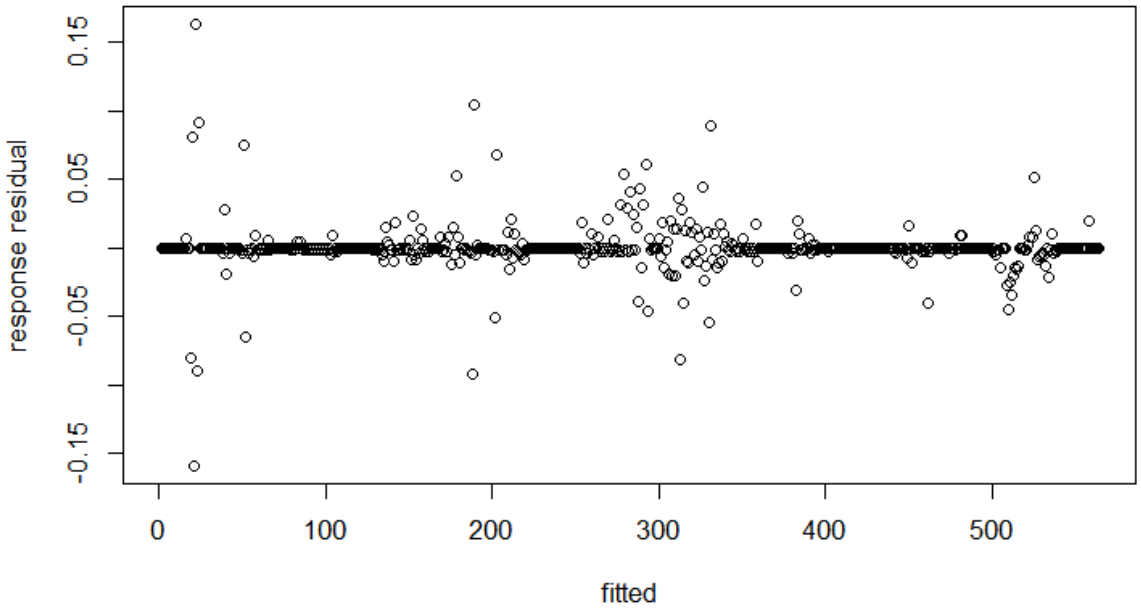

Figure 83 Fitted values and data residuals: exotic plant cover

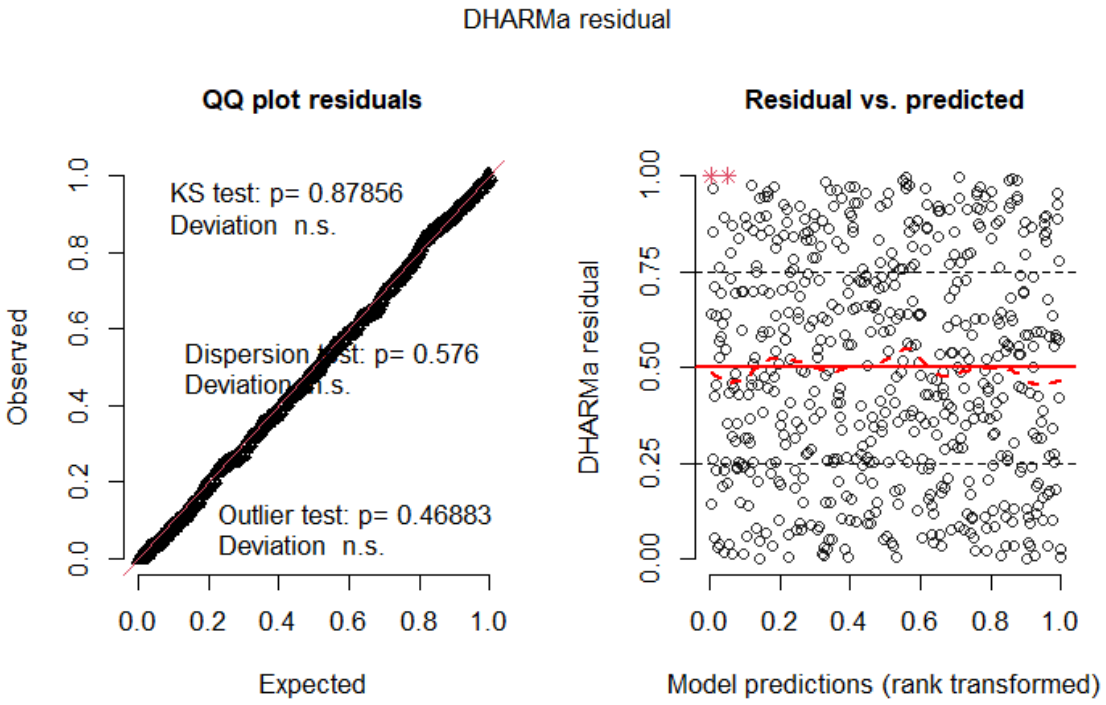

Figure 84 Simulated randomised quantile residuals: exotic plant cover

19.4 Native plant diversity

Table 47 Model fitting summary: native plant diversity

Response	Hill-Shannon diversity index calculated for native plants per 10 1m x 1m quadrats within each 0.04-hectare floristic plot Positive continuous variable
Response transformation used	None
R package and function	lmer function from the lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model formula	4_way
Random factors	Year.factor (a factor over 6 survey years) Siteplot (a factor over 66 plots) Floristic subplot (0.04-ha) (a factor over 198 subplots)
Other transformations compared	None
Other models attempted	Gaussian • 4 way: Model converged but failed residual tests with the additional singular fit warning

	• 4_way_no year factor_no_site: Model converged but year.factor accounts for substantial variance and is considered an important random effect
Confidence comments	Moderate confidence: • No convergence or fit warnings • Minor deviation from expected in Kurtosis-Skewness test • <1% non-convergence or boundary fit warnings out of 999 bootstrapped simulations for confidence interval calculations

Model summary 40 Native plant diversity

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	13.89	3.46	618.72	4.02	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	208.69	120.39	1000.78	1.73	0.08
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–8.29	7.4	539.16	–1.12	0.26
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	17.84	15.33	135.42	1.16	0.25
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	72.45	366.37	948.69	0.2	0.84
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	8.61	13.37	62.88	0.64	0.52
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	188.02	102.17	968.95	1.84	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	6932.39	3625.3	996.2	1.91	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	490.25	208	962.79	2.36	0.02
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–10.05	6.23	836.89	–1.61	0.11
site.qualitySQ2	–10.11	3.97	999.17	–2.55	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–350.35	140.8	993.04	–2.49	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	–5.32	11.65	527.16	–0.46	0.65
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–25.86	20.05	128.34	–1.29	0.2
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–155.71	499.18	893.94	–0.31	0.76
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	–4.33	16.27	61.8	–0.27	0.79
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–312.11	118.46	987.13	–2.63	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–12050.8	4224.07	989.16	–2.85	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–687.22	253.86	982.43	–2.71	0.01
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	10.08	5.89	1000.08	1.71	0.09
thinning:initSD.log:yrs.elapsed	–1.33	0.75	996.24	–1.77	0.08
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	2.35	0.88	988.56	2.67	0.01

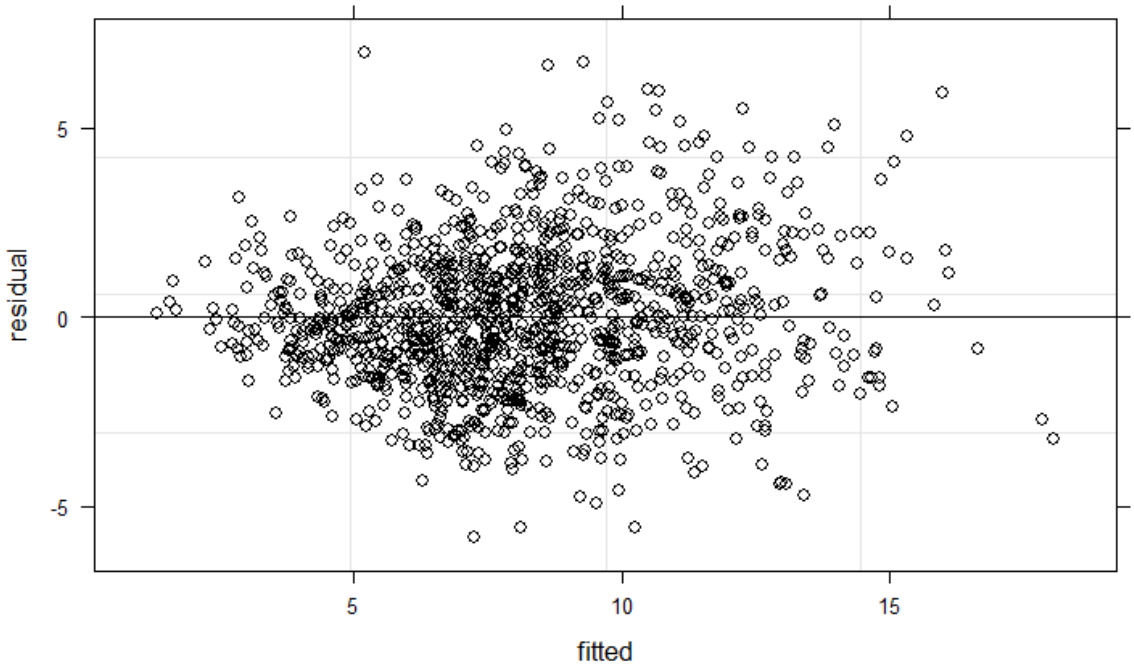

Figure 85 Fitted values and data residuals: native plant diversity

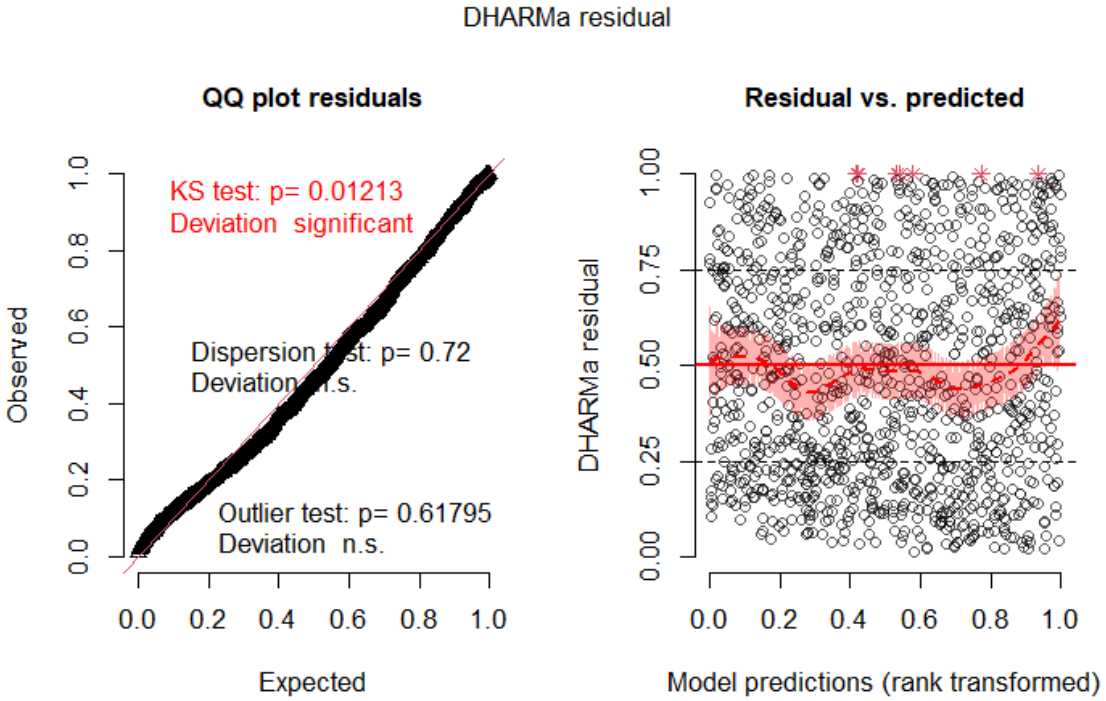

Figure 86 Simulated randomised quantile residuals: native plant diversity

19.5 Native plant species richness

Table 48 Model fitting summary: native plant species richness

Response	Number of native plant species per 0.04 ha subplot Positive integer variable
Response transformation used	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Outliers removed	None
Reported model formula	4_way
Random factors	Year.factor (a factor for each of the 6 survey years) Site (a factor over 22 sites) Siteplot (a factor over 66 plots) 0.04 ha subplot (a factor over 198 subplots)
Other transformations compared	Log
Other models attempted	Gaussian: • 4_way_no year factor: Model converged but removing year.factor did not improve overall fit and the results are erroneous. Negative binomial, quadratic parametrisation: • 4_way: Model failed to converge • 4_way_no year factor: Model failed to converge
Confidence comments	Moderate confidence: • No convergence or fit warnings • Minor deviation from expected in Kurtosis-Skewness test and two possible outliers • 4% non-convergence or boundary fit warnings out of 999 bootstrapped simulations for confidence interval calculations

Model summary 41 Native plant species richness

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	28.56	5.99	408.47	4.77	0
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0	378.08	205.99	979.49	1.84	0.07
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0	–11.24	11.69	255.2	–0.96	0.34
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0	39.66	24.73	149.57	1.6	0.11
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0	780.52	606.53	724.63	1.29	0.2
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0	–3.27	18.25	50.18	–0.18	0.86
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1	304.41	177.01	789.87	1.72	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1	11872.17	6223.79	985.01	1.91	0.06
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1	738.81	347.87	785.72	2.12	0.03
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2	–5.28	10.71	766.8	–0.49	0.62

site.qualitySQ2	–11.8	6.9	992.96	–1.71	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.0:site.qualitySQ2	–402.69	241.64	981.53	–1.67	0.1
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)2.0.0:site.qualitySQ2	10.63	18.84	290.1	0.56	0.57
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.0:site.qualitySQ2	–40.9	32.41	135.89	–1.26	0.21
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.1.0:site.qualitySQ2	–957.13	826.22	654.35	–1.16	0.25
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.2.0:site.qualitySQ2	15.37	22.37	49.98	0.69	0.5
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.1:site.qualitySQ2	–346.83	203.97	982.17	–1.7	0.09
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)1.0.1:site.qualitySQ2	–14367.9	7266.8	982.56	–1.98	0.05
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.1.1:site.qualitySQ2	–528.69	427.07	846.1	–1.24	0.22
poly(cbind(thinning, initSD.log, yrs.elapsed), 2)0.0.2:site.qualitySQ2	4.9	10.06	975.06	0.49	0.63
thinning:initSD.log:yrs.elapsed	–2.36	1.29	986.02	–1.83	0.07
site.qualitySQ2:thinning:initSD.log:yrs.elapsed	2.79	1.52	982.8	1.84	0.07

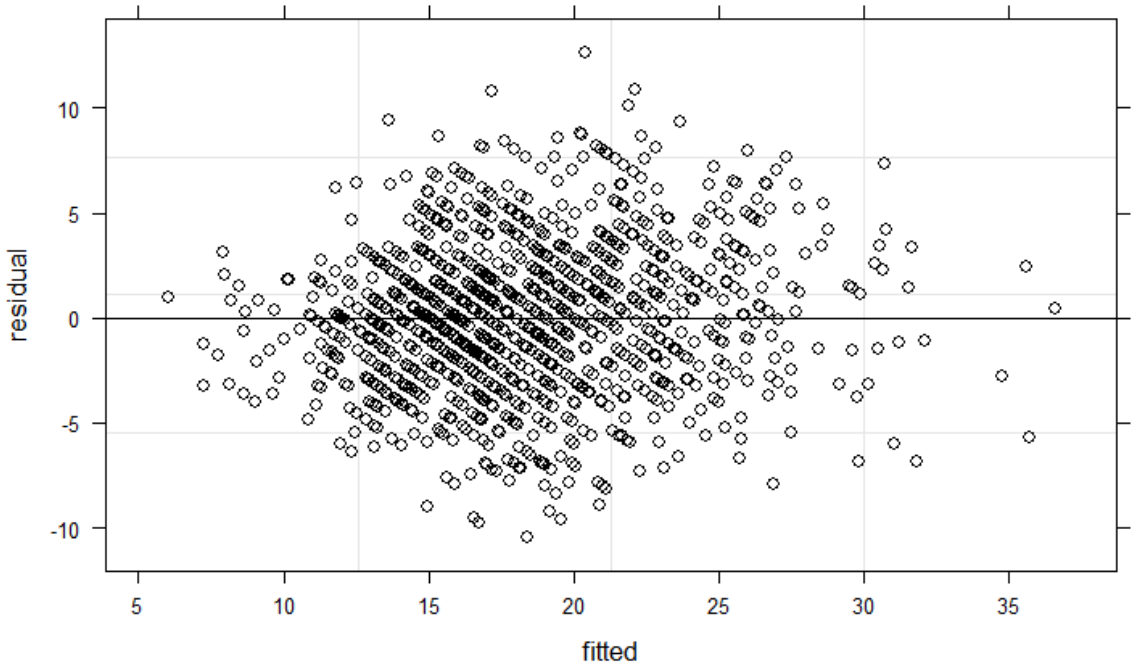

Figure 87 Fitted values and data residuals: native plant species richness

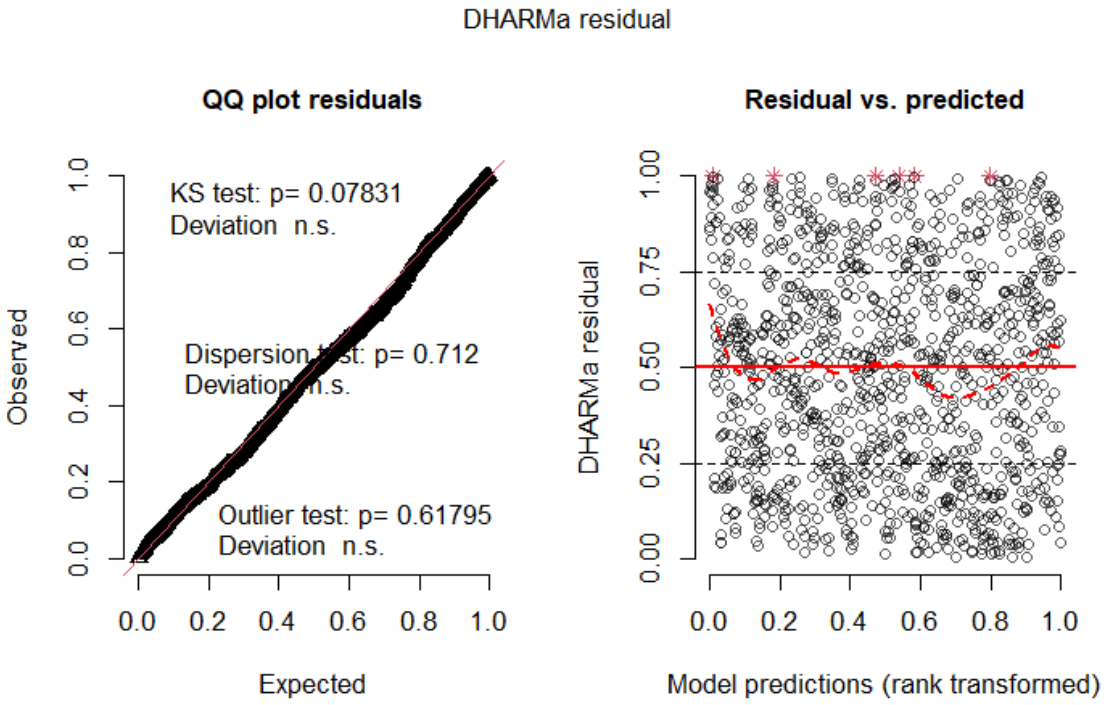

Figure 88 Simulated randomised quantile residuals: native plant species richness

19.6 Native plant cover

Table 49 Model fitting summary: native plant cover

Response	Percentage of 0.04-hectare subplot that was native vegetation Positive continuous bounded variable Modelled as the ratio of native plant cover to not native plant cover
Response transformation used	None
R package and function	glmmTMB function from glmmTMB package
Distribution used	Binomial
Outliers removed	None
Model reported	4way with yrs.elapsed removed and year factor as a fixed effect
Random factors	Siteplot (a factor over 66 plots) Subplot (a factor over 198 subplots)
Other transformations compared	Proportion (Beta models) Percentage (Gamma models) Percentage rounded to integer (Poisson and Negative Binomial models)
Other models attempted	Beta • 4_way: Non-positive definite Hessian, failed residuals tests • 4_way with no random effects for survey year: Non-positive definite Hessian, failed residuals tests

	• 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor: Non-positive definite Hessian, failed residuals tests Gamma • 4_way: Non-positive definite Hessian, failed residuals tests • 4_way (Gamma) with yrs.elapsed removed and year factor changed from random factor to fixed factor with no random effects for site: No warnings, but failed residual tests • 4_way (Gamma) with no random effects for site, siteplot, year factor: No warnings, but failed residual tests Zero-truncated Poisson • 4_way: Non-positive definite Hessian, failed residual tests • 4_way with no random effects for site, siteplot, year factor: No warnings, but failed residual tests Zero-truncated Negative binomial, linear parameterisation • 4_way: Non-positive definite Hessian Zero-truncated Negative binomial, quadratic parameterisation • 4_way: Non-positive definite Hessian • 4_way with no random effects for site, siteplot, year factor: Non-positive definite Hessian • 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but bootstrapped simulations failed • 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor with no random effects for site: No warnings, but bootstrapped simulations failed • 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor with no random effects for site or site plot: No warnings and passed bootstrapped simulations. Prediction intervals extended past 100% • 3_3way: Non-positive definite Hessian Binomial • 4_way: Non-positive definite Hessian • 3_3way : No warnings, but bootstrapped simulations failed • 4_way with yrs.elapsed removed and year factor changed from random factor to fixed factor: No warnings, but bootstrapped simulations failed • 3_3way with no random effects for site: No warnings, but bootstrapped simulations failed • 3_3way with no random effects for survey year or site: No warnings, but bootstrapped simulations failed
Confidence comments	Low to moderate confidence: • No fit warnings • Failed the Kurtosis-Skewness test, with minor deviations from expected • Some non-convergence warnings in bootstrapped prediction interval simulations (9.7% of 999)

Model summary 42 Native plant cover

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	–4.28	0.18	–23.59	0.00
poly(cbind(thinning, initSD.log), 2)1.0	–25.31	5.01	–5.05	0.00
poly(cbind(thinning, initSD.log), 2)2.0	–9.39	3.97	–2.37	0.02
poly(cbind(thinning, initSD.log), 2)0.1	–5.20	4.33	–1.20	0.23
poly(cbind(thinning, initSD.log), 2)1.1	270.98	136.68	1.98	0.05
poly(cbind(thinning, initSD.log), 2)0.2	11.67	4.09	2.85	0.00
site.qualitySQ2	–0.73	0.27	–2.66	0.01
year.factor2020	–0.45	0.16	–2.85	0.00
year.factor2021	2.05	0.16	12.51	0.00
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2	14.75	6.30	2.34	0.02
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2	2.76	6.64	0.42	0.68
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2	15.95	7.42	2.15	0.03
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2	–219.22	190.30	–1.15	0.25
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2	–39.45	7.14	–5.53	0.00
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2020	1.07	4.42	0.24	0.81
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2020	1.16	3.16	0.37	0.71
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2020	15.31	3.36	4.56	0.00
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2020	–72.19	103.74	–0.70	0.49
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2020	–4.84	2.39	–2.02	0.04
poly(cbind(thinning, initSD.log), 2)1.0:year.factor2021	31.49	3.73	8.44	0.00
poly(cbind(thinning, initSD.log), 2)2.0:year.factor2021	16.47	2.63	6.26	0.00
poly(cbind(thinning, initSD.log), 2)0.1:year.factor2021	8.44	3.82	2.21	0.03
poly(cbind(thinning, initSD.log), 2)1.1:year.factor2021	–207.74	104.34	–1.99	0.05
poly(cbind(thinning, initSD.log), 2)0.2:year.factor2021	–16.65	4.58	–3.63	0.00
site.qualitySQ2:year.factor2020	0.55	0.25	2.17	0.03
site.qualitySQ2:year.factor2021	0.11	0.23	0.50	0.62
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2020	3.25	5.57	0.58	0.56
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2020	–0.98	5.47	–0.18	0.86
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2020	–9.36	6.81	–1.37	0.17
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2020	61.57	163.83	0.38	0.71
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2020	6.85	7.05	0.97	0.33
poly(cbind(thinning, initSD.log), 2)1.0:site.qualitySQ2:year.factor2021	–16.92	4.59	–3.69	0.00
poly(cbind(thinning, initSD.log), 2)2.0:site.qualitySQ2:year.factor2021	–6.98	4.58	–1.52	0.13
poly(cbind(thinning, initSD.log), 2)0.1:site.qualitySQ2:year.factor2021	–24.97	6.11	–4.08	0.00
poly(cbind(thinning, initSD.log), 2)1.1:site.qualitySQ2:year.factor2021	104.95	145.52	0.72	0.47
poly(cbind(thinning, initSD.log), 2)0.2:site.qualitySQ2:year.factor2021	37.22	6.93	5.37	0.00

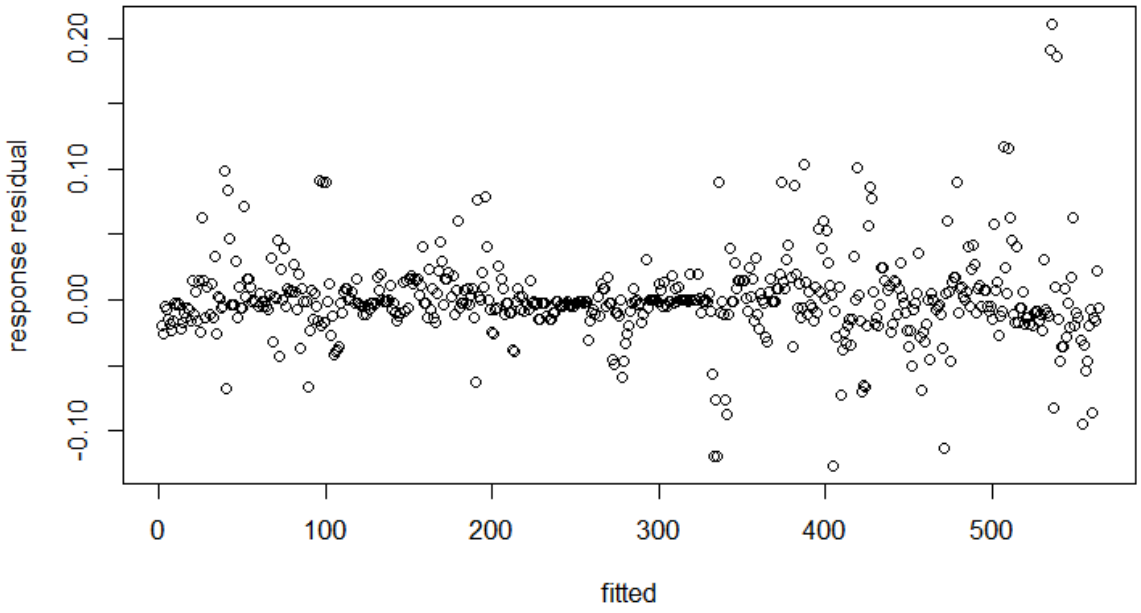

Figure 89 Fitted values and data residuals: native plant cover

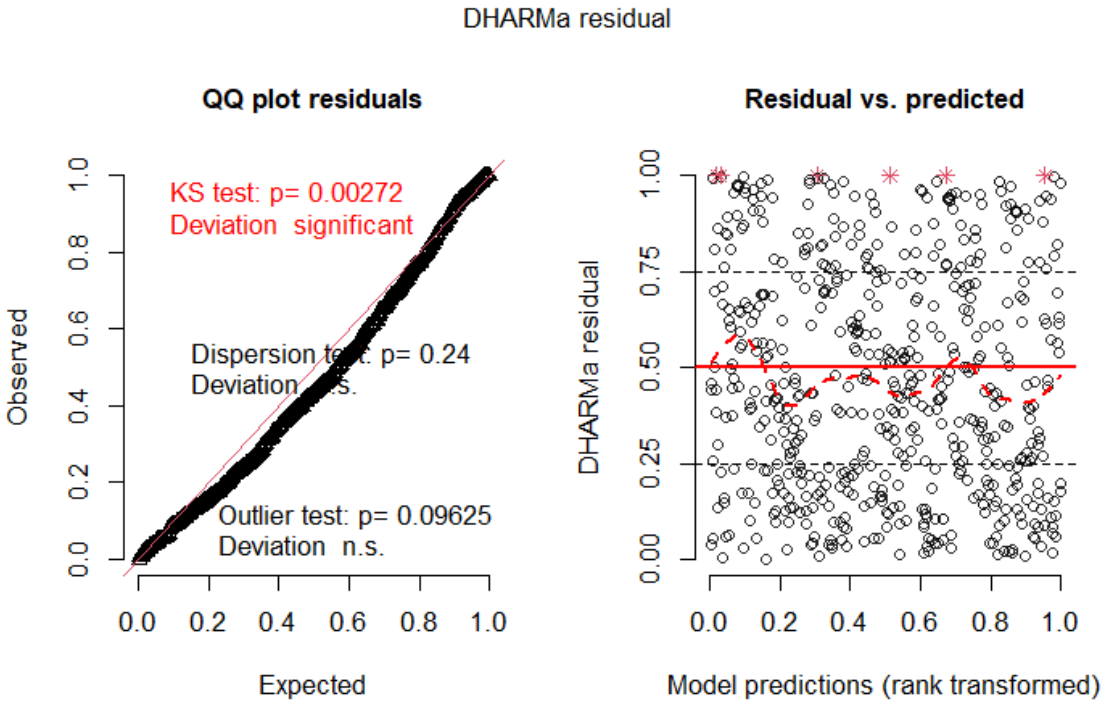

Figure 90 Simulated randomised quantile residuals: native plant cover

20. Plant species list

20.1 Native plant species list

Table 50 lists all native plant species recorded in all survey years, showing the original recorded name as well as the name assigned for analysis (where, for example, multiple sub-species were originally recorded but were analysed as the same species). The number of 0.04-hectare subplots the species was recorded in is reported for each survey year (out of 198).

Table 50 Native plant species

Original name	Analysis name	2020	2015	2018	2017	2019	2021
Acacia dealbata	*Acacia dealbata*	4	2	3	3	4	3
Acaena novae-zelandiae	*Acaena novae-zelandiae*	4	3	5	2	7	5
Acaena spp	*Acaena* spp	-	2	-	-	-	-
Alternanthera denticulata	*Alternanthera denticulata*	172	182	182	190	169	166
Amphibromus fluitans	*Amphibromus fluitans*	-	10	-	2	-	1
Amphibromus nervosus	*Amphibromus nervosus*	14	21	7	17	10	58
Amphibromus spp	*Amphibromus* spp	6	15	-	5	1	-
Amyema miquelii	*Amyema* spp	3	3	-	11	-	3
Amyema miraculosum subsp boormanii	*Amyema* spp	-	1	-	-	-	-
Amyema pendula	*Amyema* spp	-	2	-	1	-	-
Amyema spp	*Amyema* spp	13	25	25	3	21	19
Arthropodium minus	*Arthropodium minus*	16	2	3	7	5	-
Arthropodium spp	*Arthropodium* spp	-	-	-	-	4	1
Asperula spp	*Asperula* spp	-	-	-	1	-	-
Atriplex semibaccata	*Atriplex semibaccata*	4	1	3	3	5	5
Atriplex spp	*Atriplex semibaccata*	8	1	2	2	2	-
Austrostipa elegantissima	*Austrostipa elegantissima*	2	-	-	-	-	-
Austrostipa mollis	*Austrostipa mollis*	-	-	-	-	1	-
Austrostipa nodosa	*Austrostipa nodosa*	2	-	-	-	-	-
Austrostipa scabra	*Austrostipa scabra*	-	2	2	-	-	1
Austrostipa scabra subsp *falcata*	*Austrostipa scabra*	1	-	1	-	2	-
Austrostipa scabra subsp *scabra*	*Austrostipa scabra*	-	2	-	-	-	4
Austrostipa spp	*Austrostipa* spp	1	-	-	1	-	-
Azolla filiculoides	*Azolla filiculoides*	2	4	5	13	3	11
Azolla pinnata	*Azolla pinnata*	-	3	3	-	1	-
Azolla spp	*Azolla* spp	-	2	-	-	-	-

Original name	Analysis name	2020	2015	2018	2017	2019	2021
Boerhavia dominii	*Boerhavia dominii*	2	-	1	1	-	7
Bolboschoenus medianus	*Bolboschoenus medianus*	-	-	-	-	-	2
Bolboschoenus spp	*Bolboschoenus* spp	-	-	1	1	-	1
Brachyscome basaltica	*Brachyscome basaltica*	68	39	47	62	61	67
Brachyscome basaltica var gracilis	*Brachyscome basaltica*	-	3	-	-	-	-
Brachyscome spp	*Brachyscome* spp	-	-	1	1	-	-
Callitris glaucophylla	*Callitris glaucophylla*	1	-	-	-	-	-
Calotis hispidula	*Calotis hispidula*	2	-	-	-	-	-
Calotis scapigera	*Calotis scapigera*	19	10	17	10	17	20
Cardamine moirensis	*Cardamine moirensis*	-	3	-	4	7	-
Cardamine paucijuga	*Cardamine paucijuga*	40	5	9	5	1	38
Carex bichenoviana	*Carex bichenoviana*	-	3	-	-	-	-
Carex inversa	*Carex inversa*	114	140	101	79	88	114
Carex spp	*Carex* spp	3	3	4	17	23	-
Carex tereticaulis	*Carex tereticaulis*	135	146	139	140	137	125
Centella asiatica	*Centella asiatica*	8	1	6	-	6	1-
Centella cordifolia	*Centella cordifolia*	1	1	4	7	1	1
Centella spp	*Centella* spp	-	-	-	-	1	1
Centipeda cunninghamii	*Centipeda cunninghamii*	151	94	153	188	126	154
Centipeda minima	*Centipeda minima*	43	2	1	27	-	52
Centipeda minima subsp *minima*	*Centipeda minima*	-	-	1	-	-	-
Centipeda spp	*Centipeda* spp	2	1	-	-	1	-
Chamaesyce drummondii	*Chamaesyce drummondii*	-	3	4	-	-	-
Chenopodium melanocarpum	*Chenopodium melanocarpum*	-	-	-	-	-	2
Chenopodium pumilio	*Chenopodium pumilio*	-	-	-	-	-	32
Chloris truncata	*Chloris truncata*	2	-	1	1	-	4
Chrysocephalum apiculatum	*Chrysocephalum apiculatum*	1	5	-	6	-	7
Chrysocephalum spp	*Chrysocephalum* spp	1	1	-	-	-	-
Convolvulus erubescens	*Convolvulus erubescens*	-	-	-	-	-	1
Cotula australis	*Cotula australis*	60	6	15	31	22	18
Craspedia paludicola	*Craspedia paludicola*	22	-	9	17	13	17
Craspedia spp	*Craspedia paludicola*	-	10	-	1	2	-
Crassula colorata	*Crassula colorata*	3	-	-	-	-	-

Original name	Analysis name	2020	2015	2018	2017	2019	2021
Crassula colorata var *acuminata*	*Crassula colorata*	-	-	-	1	-	-
Crassula decumbens	*Crassula decumbens*	-	-	-	-	-	1
Crassula helmsii	*Crassula helmsii*	-	2	-	-	1	-
Crassula peduncularis	*Crassula peduncularis*	4	-	-	-	-	1
Crassula sieberiana	*Crassula sieberiana*	22	-	-	-	-	2
Triglochin procera	*Cycnogeton* spp	20	13	43	11	19	6
Triglochin procerum	*Cycnogeton* spp	-	-	-	-	-	51
Triglochin spp	*Cycnogeton* spp	44	15	2	24	2	10
Cymbonotus preissianus	*Cymbonotus preissianus*	-	-	-	-	-	1
Cynodon dactylon	*Cynodon dactylon*	54	69	53	49	51	63
Cyperus difformis	*Cyperus difformis*	-	-	-	-	-	10
Cyperus exaltatus	*Cyperus exaltatus*	-	8	2	10	-	3
Cyperus gunnii	*Cyperus gunnii*	-	-	-	1	-	-
Damasonium minus	*Damasonium minus*	4	15	2	11	2	41
Damasonium spp	*Damasonium minus*	-	1	-	-	-	-
Daucus glochidiatus	*Daucus glochidiatus*	29	7	8	4	10	10
Daucus spp	*Daucus glochidiatus*	-	-	-	5	-	-
Deyeuxia quadriseta	*Deyeuxia quadriseta*	6	7	12	7	3	28
Dianella longifolia	*Dianella longifolia*	18	-	9	7	4	9
Dianella longifolia var *longifolia*	*Dianella longifolia*	-	9	-	-	-	7
Dianella spp	*Dianella longifolia*	-	1	-	-	6	-
Dichelachne crinita	*Dichelachne crinita*	-	-	-	2	1	-
Dichondra repens	*Dichondra repens*	17	4	19	20	12	37
Dichondra spp	*Dichondra repens*	-	5	-	-	-	-
Dichondra sp *A*	*Dichondra* sp *A*	-	2	-	-	2	-
Dysphania pumilio	*Dysphania pumilio*	5	22	1	2	7	10
Echinochloa colona	*Echinochloa colona*	-	3	-	-	-	1
Eclipta platyglossa	*Eclipta platyglossa*	97	52	101	60	90	85
Einadia nutans	*Einadia nutans*	78	21	44	32	44	56
Einadia nutans subsp *nutans*	*Einadia nutans*	-	10	-	-	1	1
Einadia spp	*Einadia nutans*	3	-	-	-	-	-
Elatine gratioloides	*Elatine gratioloides*	1	5	-	5	-	14
Eleocharis acuta	*Eleocharis* spp	-	173	60	94	2	139
Eleocharis pallens	*Eleocharis* spp	-	-	33	94	1	-
Eleocharis plana	*Eleocharis* spp	-	-	55	50	4	8

Original name	Analysis name	2020	2015	2018	2017	2019	2021
Eleocharis pusilla	*Eleocharis* spp	47	61	50	67	38	66
Eleocharis spp	*Eleocharis* spp	159	-	48	6	148	3
Elymus scaber	*Elymus scaber*	4	7	4	-	4	4
Enchylaena tomentosa	*Enchylaena tomentosa*	7	4	2	-	3	4
Enteropogon acicularis	*Enteropogon acicularis*	-	1	-	-	-	-
Epilobium billardiereanum	*Epilobium billardiereanum*	28	9	7	39	15	12
Epilobium billardiereanum subsp *billardiereanum*	*Epilobium billardiereanum*	-	1	-	-	1	62
Epilobium billardiereanum subsp *cinereum*	*Epilobium billardiereanum*	11	2	3	10	-	14
Epilobium billardiereanum subsp *hydrophilum*	*Epilobium billardiereanum*	16	-	12	1	16	14
Epilobium billardiereanum subsp *intermedium*	*Epilobium billardiereanum*	-	-	1	-	-	-
Epilobium hirtigerum	*Epilobium hirtigerum*	12	22	10	6	1	10
Epilobium spp	*Epilobium* spp	3	1	1	1	1	5
Eragrostis elongata	*Eragrostis elongata*	-	1	-	-	-	-
Erigeron spp	*Erigeron* spp	-	-	-	4	1	9
Erodium crinitum	*Erodium crinitum*	1	-	-	-	-	-
Eryngium ovinum	*Eryngium ovinum*	1	1	1	1	1	1
Eucalyptus camaldulensis	*Eucalyptus camaldulensis*	198	198	198	198	198	169
Eucalyptus melliodora	*Eucalyptus melliodora*	1	1	1	-	1	-
Euchiton collinus	*Euchiton collinus*	2	-	-	-	-	-
Euchiton gymnocephalus	*Euchiton gymnocephalus*	1	-	-	-	-	-
Euchiton involucratus	*Euchiton involucratus*	1	8	8	5	1	13
Euchiton sphaericus	*Euchiton sphaericus*	41	15	6	41	28	66
Euchiton spp	*Euchiton* spp	7	1	6	4	6	1
Eulalia aurea	*Eulalia aurea*	-	2	-	1	-	13
Euphorbia drummondii	*Euphorbia drummondii*	61	35	52	55	53	56
Exocarpos sparteus	*Exocarpos sparteus*	-	-	-	-	-	1
Exocarpos strictus	*Exocarpos strictus*	10	12	9	10	10	8
Fimbristylis aestivalis	*Fimbristylis aestivalis*	2	-	-	1	1	-
Geranium homeanum	*Geranium homeanum*	1	-	-	-	-	-
Geranium spp	*Geranium homeanum*	-	-	1	-	1	-
Glinus lotoides	*Glinus lotoides*	-	-	-	1	-	-

Original name	Analysis name	2020	2015	2018	2017	2019	2021
Glossostigma elatinoides	*Glossostigma elatinoides*	3	-	4	6	1	11
Glossostigma spp	*Glossostigma elatinoides*	-	-	-	2	-	-
Goodenia geniculata	*Goodenia geniculata*	-	1	-	-	-	-
Goodenia glabra	*Goodenia glabra*	1	-	-	-	-	-
Goodenia gracilis	*Goodenia gracilis*	58	50	47	55	60	68
Goodenia spp	*Goodenia gracilis*	1	1	-	-	-	-
Gratiola pedunculata	*Gratiola pedunculata*	-	-	-	-	-	9
Gratiola peruviana	*Gratiola peruviana*	1	2	1	1	1	-
Gratiola pumilo	*Gratiola pumilo*	3	-	1	2	-	-
Haloragis heterophylla	*Haloragis heterophylla*	1	1	-	3	3	3
Haloragis spp	*Haloragis heterophylla*	2	-	-	-	-	1
Helichrysum bracteatum	*Helichrysum bracteatum*	-	1	24	29	-	-
Hydrocotyle laxiflora	*Hydrocotyle laxiflora*	-	-	-	-	-	1
Hydrocotyle sibthorpioides	*Hydrocotyle sibthorpioides*	2	1	4	5	4	6
Hydrocotyle spp	*Hydrocotyle sibthorpioides*	1	6	-	-	-	1
Hypericum gramineum	*Hypericum gramineum*	5	3	2	1	4	10
Isolepis hookeriana	*Isolepis hookeriana*	-	1	-	-	-	-
Isotoma spp	*Isotoma* spp	1	-	-	-	-	-
Juncus amabilis	*Juncus amabilis*	132	153	142	113	136	125
Juncus aridicola	*Juncus aridicola*	-	1	1	2	-	4
Juncus australis	*Juncus australis*	-	3	-	-	-	-
Juncus bufonius	*Juncus bufonius*	3	-	-	-	-	1
Juncus flavidus	*Juncus flavidus*	-	13	4	18	5	15
Juncus holoschoenus	*Juncus holoschoenus*	5	28	14	13	7	42
Juncus ingens	*Juncus ingens*	11	10	11	13	12	6
Juncus pallidus	*Juncus pallidus*	-	-	-	-	-	2
Juncus procerus	*Juncus procerus*	-	-	-	2	-	-
Juncus radula	*Juncus radula*	2	-	-	1	8	2
Juncus remotiflorus	*Juncus remotiflorus*	-	1	-	-	2	-
Juncus semisolidus	*Juncus semisolidus*	-	-	2	-	-	-
Juncus subglaucus	*Juncus subglaucus*	1	7	-	1	-	7
Juncus subsecundus	*Juncus subsecundus*	2	18	18	14	9	5
Lachnagrostis filiformis	*Lachnagrostis filiformis*	136	125	102	186	131	145
Lachnagrostis spp	*Lachnagrostis* spp	-	2	-	-	-	-
Leiocarpa panaetioides	*Leiocarpa panaetioides*	4	-	-	-	-	-
Lemna disperma	*Lemna disperma*	-	-	2	-	-	1

Original name	Analysis name	2020	2015	2018	2017	2019	2021
Lepidium africanum	*Lepidium pseudohyssopifolium*	-	-	-	-	1	-
Lepidium hyssopifolium	*Lepidium pseudohyssopifolium*	1	-	-	-	-	-
Lepidium pseudohyssopifolium	*Lepidium pseudohyssopifolium*	4	-	3	1	-	-
Limosella australis	*Limosella australis*	-	-	-	-	-	1
Limosella spp	*Limosella* spp	-	-	-	1	-	-
Linum marginale	*Linum marginale*	19	13	13	16	18	22
Ludwigia peploides	*Ludwigia peploides*	4	2	7	8	4	15
Ludwigia peploides subsp montevidensis	*Ludwigia peploides*	3	13	2	7	8	4
Lythrum hyssopifolia	*Lythrum hyssopifolia*	53	21	19	51	22	87
Lythrum spp	*Lythrum hyssopifolia*	-	-	-	-	1	-
Maireana enchylaenoides	*Maireana enchylaenoides*	-	-	-	1	1	-
Marsilea angustifolia	*Marsilea angustifolia*	-	-	-	1	-	-
Marsilea costulifera	*Marsilea costulifera*	30	35	34	25	23	70
Marselea drummondii	*Marsilea drummondii*	-	-	1	-	-	-
Marsilea drummondii	*Marsilea drummondii*	24	27	21	31	15	37
Marsilea spp	*Marsilea* spp	1	3	-	6	-	-
Mentha australis	*Mentha australis*	1	-	-	1	1	3
Mentha laxiflora	*Mentha australis*	-	1	-	-	-	-
Mentha spp	*Mentha australis*	1	-	1	-	-	-
Mentha australis	*Mentha diemenica*	-	-	-	1	-	-
Mentha diemenica	*Mentha diemenica*	4	2	4	-	2	3
Mentha satureioides	*Mentha diemenica*	-	-	-	-	1	-
Mentha spp	*Mentha diemenica*	-	2	-	1	-	-
Mentha satureioides	*Mentha satureioides*	-	1	1	-	-	-
Microlaena stipoides var *stipoides*	*Microlaena stipoides*	1	-	-	-	-	-
Mimulus gracilis	*Mimulus gracilis*	1	-	-	-	-	-
Mimulus repens	*Mimulus repens*	1	-	-	-	-	1
Myriophyllum crispatum	*Myriophyllum* spp	46	16	60	64	56	86
Myriophyllum papillosum	*Myriophyllum* spp	4	2	15	18	9	1
Myriophyllum simulans	*Myriophyllum* spp	3	-	-	-	-	-
Myriophyllum spp	*Myriophyllum spp*	8	53	2	17	3	1
Nymphoides crenata	*Nymphoides crenata*	21	25	31	24	20	27
Ophioglossum lusitanicum	*Ophioglossum lusitanicum*	1	-	-	-	-	-

Original name	Analysis name	2020	2015	2018	2017	2019	2021
Ottelia ovalifolia	*Ottelia ovalifolia*	2	1	-	-	-	-
Ottelia ovalifolia subsp *ovalifolia*	*Ottelia ovalifolia*	-	6	-	-	-	-
Ottelia spp	*Ottelia* spp	-	1	-	-	-	-
Oxalis perennans	*Oxalis perennans*	68	63	58	49	53	79
Oxalis spp	*Oxalis perennans*	-	5	-	-	-	-
Parietaria debilis	*Parietaria debilis*	9	-	-	-	-	1
Paspalidium jubiflorum	*Paspalidium jubiflorum*	157	165	168	150	168	149
Paspalum distichum	*Paspalum distichum*	-	3	-	2	-	-
Persicaria decipiens	*Persicaria decipiens*	34	50	40	54	37	46
Persicaria hydropiper	*Persicaria hydropiper*	21	25	21	36	27	38
Persicaria prostrata	*Persicaria prostrata*	30	30	33	48	25	50
Phragmites australis	*Phragmites australis*	2	4	4	3	4	2
Plantago cunninghamii	*Plantago cunninghamii*	-	1	-	-	-	-
Plantago gaudichaudii	*Plantago gaudichaudii*	-	-	1	1	-	-
Poa labillardierei	*Poa labillardierei*	8	5	-	1	5	1
Poa labillardierei var *labillardierei*	*Poa labillardierei*	-	11	-	1	1	3
Poa labillardieri	*Poa labillardierei*	-	-	7	12	-	9
Pogonolepis muelleriana	*Pogonolepis muelleriana*	-	-	-	-	1	-
Potamogeton cheesemanii	*Potamogeton cheesemanii*	7	1	11	10	4	15
Potamogeton spp	*Potamogeton* spp	-	1	-	-	1	-
Pratia concolor	*Pratia concolor*	54	35	49	60	59	59
Pratia pedunculata	*Pratia pedunculata*	-	1	-	-	-	-
Pratia purpurascens	*Pratia purpurascens*	-	-	-	-	-	2
Gnaphalium luteoalbum	*Pseudognaphalium luteoalbum*	-	-	-	4	-	-
Pseudognaphalium luteoalbum	*Pseudognaphalium luteoalbum*	-	2	-	-	35	89
Pseudognaphalium luteoalbum	*Pseudognaphalium luteoalbum*	62	14	53	110	-	-
Pseudoraphis spinescens	*Pseudoraphis spinescens*	21	16	27	26	29	18
Pycnosorus globosus	*Pycnosorus globosus*	1	-	-	-	-	-
Ranunculus inundatus	*Ranunculus inundatus*	75	42	48	76	48	87
Ranunculus lappaceus	*Ranunculus lappaceus*	4	-	2	3	1	-
Ranunculus pumilio	*Ranunculus pumilio*	35	-	2	2	3	7
Ranunculus pumilio var *politus*	*Ranunculus pumilio*	-	-	-	10	-	-
Ranunculus spp	*Ranunculus* spp	1	9	-	7	2	2

Original name	Analysis name	2020	2015	2018	2017	2019	2021
Rhodanthe corymbiflora	*Rhodanthe corymbiflora*	21	-	3	1	1	-
Rorippa laciniata	*Rorippa laciniata*	-	-	-	-	-	1
Rorippa spp	*Rorippa laciniata*	-	1	-	-	-	-
Rubus parvifolius	*Rubus parvifolius*	1	-	-	-	-	-
Rumex brownii	*Rumex brownii*	123	106	41	123	15	158
Rumex tenax	*Rumex tenax*	4	-	14	41	1	-
Austrodanthonia spp	*Rytidosperma* spp	-	1	-	-	-	-
Rytidosperma bipartitum	*Rytidosperma spp*	-	-	-	1	-	-
Rytidosperma caespitosum	*Rytidosperma spp*	2	3	6	-	10	1
Rytidosperma duttonianum	*Rytidosperma* spp	3	2	-	3	-	9
Rytidosperma erianthum	*Rytidosperma* spp	1	-	1	-	2	-
Rytidosperma fulvum	*Rytidosperma* spp	-	3	1	5	-	-
Rytidosperma monticola	*Rytidosperma* spp	9	-	-	-	-	11
Rytidosperma penicillatum	*Rytidosperma* spp	-	-	-	-	-	6
Rytidosperma pilosum	*Rytidosperma* spp	-	-	1	-	-	10
Rytidosperma racemosum	*Rytidosperma* spp	-	-	-	-	-	1
Rytidosperma setaceum	*Rytidosperma* spp	22	27	9	8	8	4
Rytidosperma spp	*Rytidosperma* spp	28	8	16	9	17	19
Salsola australis	*Salsola australis*	2	-	-	-	-	4
Salsola spp	*Salsola australis*	-	1	-	-	-	-
Salsola kali	*Salsola kali*	-	-	-	-	-	1
Sclerolaena muricata var semiglabra	*Sclerolaena muricata*	-	1	-	-	-	-
Senecio bathurstianus	*Senecio bathurstianus*	-	-	-	-	1	-
Senecio campylocarpus	*Senecio campylocarpus*	16	5	8	5	15	8
Senecio quadridentatus	*Senecio quadridentatus*	164	164	148	148	157	110
Senecio runcinifolius	*Senecio runcinifolius*	6	14	6	8	5	6
Senecio tenuiflorus	*Senecio tenuiflorus*	-	-	-	-	-	6
Sigesbeckia orientalis	*Sigesbeckia orientalis*	29	13	21	31	27	44
Sigesbeckia orientalis subsp orientalis	*Sigesbeckia orientalis*	-	3	-	-	-	-
Sigesbeckia spp	*Sigesbeckia* spp	-	2	-	-	-	-
Solanum aviculare	*Solanum aviculare*	1	-	-	-	-	-
Solenogyne bellioides	*Solenogyne bellioides*	-	-	-	-	-	1
Solenogyne dominii	*Solenogyne dominii*	3	6	7	4	8	14

Original name	Analysis name	2020	2015	2018	2017	2019	2021
Spergularia brevifolia	*Spergularia brevifolia*	2	-	2	1	7	2
Stellaria angustifolia	*Stellaria angustifolia*	37	35	32	41	36	35
Stellaria caespitosa	*Stellaria angustifolia*	1	-	-	9	-	-
Stellaria spaff-angustifolia	*Stellaria angustifolia*	-	-	-	2	-	-
Stellaria pungens	*Stellaria pungens*	-	3	-	1	-	3
Typha australis	*Typha* spp	-	-	1	-	-	1
Typha domingensis	*Typha* spp	-	1	1	1	-	-
Typha orientalis	*Typha* spp	-	2	-	-	-	3
Typha spp	*Typha* spp	-	1	-	2	2	2
Verbena gaudichaudii	*Verbena gaudichaudii*	-	4	2	4	-	-
Viola betonicifolia	*Viola betonicifolia*	1	1	-	-	-	-
Viola spp	*Viola betonicifolia*	-	1	-	2	-	-
Vittadinia cuneata	*Vittadinia cuneata*	53	2	42	33	31	27
Vittadinia cuneata var cuneata	*Vittadinia cuneata*	-	4	-	1	-	-
Vittadinia cuneata var hirsuta	*Vittadinia cuneata*	-	-	1	-	-	-
Vittadinia gracilis	*Vittadinia gracilis*	124	36	62	51	92	54
Vittadinia spp	*Vittadinia spp*	-	1	-	1	-	-
Vulpia bromoides	*Vulpia bromoides*	4	6	-	4	2	-
Wahlenbergia communis	*Wahlenbergia* spp	-	1	8	-	-	-
Wahlenbergia fluminalis	*Wahlenbergia* spp	50	27	48	20	66	104
Wahlenbergia gracilenta	*Wahlenbergia* spp	1	2	1	-	-	-
Wahlenbergia gracilis	*Wahlenbergia* spp	3	13	-	-	4	-
Wahlenbergia spp	*Wahlenbergia* spp	60	84	38	91	46	9
Walwhalleya proluta	*Walwhalleya proluta*	-	-	1	1	-	1
Xerochrysum bracteatum	*Xerochrysum bracteatum*	64	25	1	1	47	66

20.2 Exotic plant species list

Table 51 lists all exotic plant species recorded in all survey years, showing the original recorded name as well as the name assigned for analysis (where, for example, multiple sub-species were originally recorded but were analysed as the same species). The number of 0.04-hectare subplots the species was recorded in is reported for each survey year (out of 198).

Table 51 Exotic plant species

Original name	Analysis name	2015	2017	2018	2019	2020	2021
Aira caryophyllea	*Aira caryophyllea*	3	-	-	-	-	-
Aira cupaniana	*Aira cupaniana*	10	1	4	-	-	-
Aira elegantissima	*Aira elegantissima*	5	-	-	4	1	1
Aira spp	*Aira* spp	1	-	3	2	-	-
Alopecurus spp	*Alopecurus* spp	2	-	-	-	-	-
Amsinckia spp	*Amsinckia* spp	2	-	-	-	-	-
Anagallis arvensis	*Anagallis arvensis*	79	26	43	50	71	41
Anagallis spp	*Anagallis* spp	-	-	-	-	1	-
Anthoxanthum odoratum	*Anthoxanthum odoratum*	-	1	-	1	-	-
Anthoxanthum spp	*Anthoxanthum odoratum*	-	-	-	1	-	-
Arctotheca calendula	*Arctotheca calendula*	11	1	-	1	-	1
Arctotheca spp	*Arctotheca* spp	-	-	-	1	-	-
Aster spp	*Aster* spp	-	-	1	-	1	1
Aster subulatus	*Aster subulatus*	21	47	28	34	13	35
Avena barbata	*Avena barbata*	5	19	4	3	7	3
Avena fatua	*Avena fatua*	1	6	-	2	2	1
Avena sativa	*Avena sativa*	-	-	-	-	2	-
Avena spp	*Avena* spp	-	1	1	-	4	1
Brassica tournefortii	*Brassica tournefortii*	1	-	-	-	-	1
Briza minor	*Briza minor*	4	2	-	5	-	-
Bromus catharticus	*Bromus catharticus*	2	-	-	-	-	-
Bromus diandrus	*Bromus diandrus*	1	1	2	1	-	-
Bromus hordeaceus	*Bromus hordeaceus*	3	2	5	1	1	-
Bromus molliformis	*Bromus molliformis*	3	8	-	-	4	-
Bromus rubens	*Bromus rubens*	2	-	-	1	1	-
Callitriche stagnalis	*Callitriche stagnalis*	-	-	-	3	-	-
Capsella bursa-pastoris	*Capsella bursa-pastoris*	12	-	1	3	7	5
Cardamine hirsuta	*Cardamine hirsuta*	1	-	-	-	-	-
Carduus pycnocephalus	*Carduus pycnocephalus*	2	-	-	-	-	-

Original name	Analysis name	2015	2017	2018	2019	2020	2021
Carduus spp	*Carduus* spp	1	-	-	1	-	-
Carduus tenuiflorus	*Carduus tenuiflorus*	-	2	-	1	3	1
Centaurea melitensis	*Centaurea melitensis*	5	1	2	2	2	-
Centaurium spp	*Centaurium tenuiflorum*	4	-	-	-	-	1
Centaurium tenuiflorum	*Centaurium tenuiflorum*	8	5	2	9	1	17
Cerastium glomeratum	*Cerastium glomeratum*	21	-	-	-	-	12
Chenopodium album	*Chenopodium album*	-	1	-	-	4	2
Chondrilla juncea	*Chondrilla juncea*	63	-	12	-	10	15
Cirsium spp	*Cirsium vulgare*	-	-	-	-	12	-
Cirsium vulgare	*Cirsium vulgare*	15-	131	139	149	107	110
Conyza albida	*Conyza* spp	-	-	-	-	-	2
Conyza bonariensis	*Conyza* spp	13	113	14	43	-	26
Conyza canadensis	*Conyza* spp	1	2	11	9	-	4
Conyza spp	*Conyza* spp	132	19	136	146	118	8-
Conyza sumatrensis	*Conyza* spp	15	27	9	17	7	1
Cotula bipinnata	*Cotula bipinnata*	1	-	-	-	-	-
Cotula coronopifolia	*Cotula coronopifolia*	2	-	-	-	-	-
Cucumis myriocarpus	*Cucumis myriocarpus*	1	-	-	-	1	8
Cucumis myriocarpus subsp leptodermis	*Cucumis myriocarpus*	-	8	-	-	1	2
Cyperus eragrostis	*Cyperus eragrostis*	2	3	-	26	3	11
Datura stramonium	*Datura stramonium*	-	-	-	-	-	8
Dittrichia graveolens	*Dittrichia graveolens*	1	-	1	1	-	9
Echinochloa crus-galli	*Echinochloa crus-galli*	-	1	-	-	-	-
Echium plantagineum	*Echium plantagineum*	76	81	55	77	85	43
Echium spp	*Echium plantagineum*	1	-	-	-	1	8
Echium vulgare	*Echium vulgare*	-	1	-	-	1	4
Ehrharta erecta	*Ehrharta erecta*	1	1	4	2	1	-
Ehrharta longiflora	*Ehrharta longiflora*	8	5	4	1	-	4
Euphorbia peplus	*Euphorbia peplus*	4	-	3	1	4	5
Fumaria muralis	*Fumaria muralis*	52	12	44	32	48	27
Fumaria muralis subsp *muralis*	*Fumaria muralis*	-	2	-	-	-	-
Fumaria officinalis	*Fumaria officinalis*	-	3	-	-	-	-
Fumaria spp	*Fumaria* spp	-	9	-	-	-	1
Galium aparine	*Galium aparine*	5	5	7	3	8	2
Galium murale	*Galium murale*	1	-	-	-	-	-
Gamochaeta purpurea	*Gamochaeta purpurea*	-	-	-	-	-	1

Original name	Analysis name	2015	2017	2018	2019	2020	2021
Gamochaeta spp	*Gamochaeta* spp	1	-	-	-	-	1
Gnaphalium polycaulon	*Gnaphalium polycaulon*	-	-	-	2	-	-
Hedypnois rhagadioloides	*Hedypnois rhagadioloides*	1	1	-	6	-	-
Heliotropium europaeum	*Heliotropium europaeum*	-	2	-	1	-	-
Helminthotheca echioides	*Helminthotheca echioides*	45	12	1	31	15	47
Hordeum glaucum	*Hordeum glaucum*	39	-	4	1	1-	-
Hordeum spp	*Hordeum glaucum*	7	-	-	-	-	-
Hypericum perforatum	*Hypericum perforatum*	8	3	4	-	5	-
Hypochaeris microcephala	*Hypochaeris albiflora*	2	-	-	-	-	12
Hypochaeris glabra	*Hypochaeris glabra*	36	44	15	29	32	1-
Hypochaeris radicata	*Hypochaeris radicata*	92	34	41	51	81	5-
Hypochaeris spp	*Hypochaeris radicata*	3	2	1	3	-	6
Kickxia elatine subsp *crinita*	*Kickxia elatine* subsp *crinita*	1	-	-	-	1	1
Lactuca saligna	*Lactuca saligna*	3	1	4	13	1	19
Lactuca serriola	*Lactuca serriola*	144	100	87	118	130	9-
Lactuca spp	*Lactuca serriola*	-	-	1	-	-	1
Leontodon taraxacoides	*Leontodon taraxacoides*	4	-	2	2	-	1
Leontodon taraxacoides subsp *taraxacoides*	*Leontodon taraxacoides*	-	1	-	-	-	-
Lepidium africanum	*Lepidium africanum*	2	-	-	-	-	3
Lolium loliaceum	*Lolium loliaceum*	1	1	2	-	7	-
Lolium perenne	*Lolium perenne*	40	2	-	2	4	9
Lolium rigidum	*Lolium rigidum*	28	26	19	35	29	-
Lolium spp	*Lolium* spp	1	-	-	1	2	-
Lotus subbiflorus	*Lotus subbiflorus*	-	1	-	-	-	-
Ludwigia palustris	*Ludwigia palustris*	3	3	10	13	2	24
Marrubium vulgare	*Marrubium vulgare*	39	9	28	21	31	19
Medicago arabica	*Medicago arabica*	2	-	-	-	-	-
Medicago polymorpha	*Medicago polymorpha*	4	-	2	1	1	-
Medicago spp	*Medicago* spp	-	-	-	1	-	-
Mentha pulegium	*Mentha pulegium*	2	1	2	2	1	5
Mentha spp	*Mentha pulegium*	-	-	-	1	1	-
Modiola caroliniana	*Modiola caroliniana*	1	-	1	1	2	2

Original name	Analysis name	2015	2017	2018	2019	2020	2021
Modiola spp	*Modiola caroliniana*	-	-	-	1	-	-
Rorippa nasturtium-aquaticum	*Nasturtium officinale*	-	1	-	-	-	-
Olea europaea	*Olea europaea*	-	-	-	-	-	1
Panicum capillare	*Panicum capillare*	-	-	1	-	-	1
Panicum spp	*Panicum capillare*	1	-	2	-	-	-
Paspalum dilatatum	*Paspalum dilatatum*	1	-	-	-	-	-
Petrorhagia dubia	*Petrorhagia dubia*	9	12	5	11	7	6
Petrorhagia spp	*Petrorhagia dubia*	-	1	-	-	-	-
Phalaris paradoxa	*Phalaris paradoxa*	24	1	7	11	13	6
Phalaris spp	*Phalaris paradoxa*	1	-	-	1	-	1
Phyla canescens	*Phyla canescens*	8	-	7	5	7	12
Phyla nodiflora	*Phyla nodiflora*	-	-	3	-	-	-
Plantago coronopus	*Plantago coronopus*	-	-	-	-	3	-
Plantago coronopus subsp coronopus	*Plantago coronopus*	1	1	-	1	-	-
Plantago lanceolata	*Plantago lanceolata*	-	-	-	-	-	2
Poa annua	*Poa annua*	1	-	-	-	-	-
Polycarpon tetraphyllum	*Polycarpon tetraphyllum*	4	1	-	-	-	7
Polygonum arenastrum	*Polygonum aviculare*	-	3	-	-	-	-
Polygonum aviculare	*Polygonum aviculare*	16	7	7	25	9	65
Polygonum spp	*Polygonum aviculare*	-	2	-	-	-	-
Ranunculus repens	*Ranunculus repens*	-	-	-	-	-	1
Romulea rosea	*Romulea rosea*	1	-	-	-	-	-
Rorippa palustris	*Rorippa palustris*	-	-	1	1	-	-
Rosa rubiginosa	*Rosa rubiginosa*	-	-	-	-	-	1
Rosa spp	*Rosa* spp	1	-	1	-	-	-
Rostraria cristata	*Rostraria cristata*	-	3	-	-	-	-
Rostraria spp	*Rostraria cristata*	3	-	-	-	-	-
Rubus fruticosus	*Rubus fruticosus*	1	-	2	1	2	3
Rubus fruticosus sp agg	*Rubus fruticosus*	-	1	1	1	-	-
Sagittaria platyphylla	*Sagittaria platyphylla*	2	2	2	2	2	1
Salvia spp	*Salvia* spp	-	-	-	1	-	-
Scorzonera laciniata	*Scorzonera laciniata*	-	-	-	1	-	-
Setaria pumila	*Setaria pumila*	-	-	-	-	-	1
Silene gallica var *gallica*	*Silene gallica*	1	-	-	-	-	-

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Sisymbrium erysimoides	*Sisymbrium erysimoides*	3	-	-	-	-	5
Sisymbrium irio	*Sisymbrium irio*	2	-	-	1	3	-
Sisymbrium orientale	*Sisymbrium orientale*	1	-	-	-	-	4
Sisymbrium spp	*Sisymbrium* spp	1	-	-	-	-	-
Solanum nigrum	*Solanum nigrum*	116	57	115	130	88	104
Sonchus asper	*Sonchus asper*	31	21	22	49	17	10
Sonchus oleraceus	*Sonchus oleraceus*	159	149	134	158	167	143
Sonchus spp	*Sonchus* spp	1	-	1	2	1	-
Spergularia diandra	*Spergularia diandra*	-	2	-	-	-	-
Spergularia rubra	*Spergularia rubra*	7	-	-	-	-	5
Stachys arvensis	*Stachys arvensis*	1	-	-	-	-	1
Stychus arvensis	*Stachys arvensis*	1	-	-	-	-	-
Stellaria media	*Stellaria media*	43	4	4	17	10	8
Stellaria pallida	*Stellaria pallida*	-	-	-	-	2	-
Taraxacum officinale	*Taraxacum officinale*	3	2	1	1	-	-
Trifolium angustifolium	*Trifolium angustifolium*	3	-	2	2	-	-
Trifolium arvense	*Trifolium arvense*	36	16	7	12	15	14
Trifolium arvense var *arvense*	*Trifolium arvense*	-	-	-	4	-	-
Trifolium campestre	*Trifolium campestre*	21	11	6	6	4	-
Trifolium cernuum	*Trifolium cernuum*	9	1	1	9	-	1
Trifolium dubium	*Trifolium dubium*	-	-	-	10	-	-
Trifolium globosum	*Trifolium globosum*	-	-	1	-	-	-
Trifolium glomeratum	*Trifolium glomeratum*	87	3	20	32	44	6
Trifolium hirtum	*Trifolium hirtum*	4	2	1	-	5	-
Trifolium spp	*Trifolium* spp	4	6	-	1	5	1
Trifolium striatum	*Trifolium striatum*	2	-	-	-	-	-
Trifolium subterraneum	*Trifolium subterraneum*	1	-	-	1	-	-
Trifolium suffocatum	*Trifolium suffocatum*	1	-	-	-	-	-
Trifolium tomentosum	*Trifolium tomentosum*	8	-	-	1	-	1
Trifolium tomentosum var tomentosum	*Trifolium tomentosum*	1	-	-	5	-	-
Urtica urens	*Urtica urens*	-	-	-	3	1	-
Verbascum spp	*Verbascum* spp	3	-	-	-	-	-
Verbascum virgatum	*Verbascum virgatum*	13	1	16	8	15	9
Verbena bonariensis	*Verbena bonariensis*	38	9	37	32	33	42
Verbena officinalis	*Verbena officinalis*	19	-	16	13	11	12

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Veronica peregrina	*Veronica peregrina*	20	-	-	17	-	8
Vicia disperma	*Vicia* spp	1	-	-	-	3	-
Vicia hirsuta	*Vicia* spp	-	2	4	-	-	3
Vicia sativa	*Vicia* spp	-	-	-	1	-	1
Vicia sativa subsp *nigra*	*Vicia* spp	-	-	-	-	1	-
Vicia spp	*Vicia* spp	-	1	1	2	-	-
Vulpia muralis	*Vulpia muralis*	45	8	12	6	-	2
Vulpia myuros	*Vulpia myuros*	3	5	1	6	-	-
Vulpia myuros f megalura	*Vulpia myuros*	-	2	-	-	-	-
Vulpia spp	*Vulpia* spp	-	1	-	2	1	-
Xanthium spinosum	*Xanthium spinosum*	2	6	5	3	5	24
Xanthium spp	*Xanthium* spp	2	-	-	1	3	-