NSW NATIONAL PARKS & WILDLIFE SERVICE

River Red Gum Ecological Thinning Trial

Monitoring report 2020 – Appendices

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Cover photo: Botanists conducting floristic monitoring in thinned river red gum forest. Evan Curtis.

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Contents

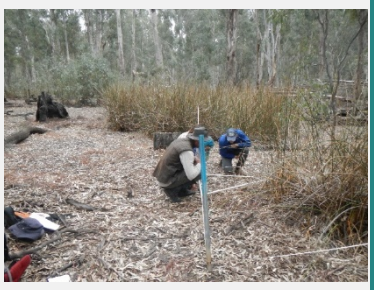
Appendix A: Photo points

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			

SITE 2 – Site Quality 1

	Control 2-2-A	Moderate 2-3-C	Heavy 2-1-C
2015			
2017			
2018			
2019			

SITE 7 – Site Quality 2

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

SITE 10 – Site Quality 2

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

SITE 22 – Site Quality 1

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

Appendix B: Model summaries – Tree parameters

B.1 Tree growth rates

Table 1 Model fitting summary: tree growth rate by tree size

Response	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
Other transformations compared	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	None
Outliers removed	growth.per.year <–5 (13 values) growth.per.year >15 (5 values) diameter.first >1100 (26 values)
Fixed factors	Diameter.first.m – tree diameter at breast height in metres at initial survey (metres used to make the scale of the response and predictors similar) Ecological thinning treatment (control, moderate, heavy) Site quality (SQ1, SQ2)
Fixed factor interactions	Two interactions were included: diameter first * site quality and diameter first * treatment. No other interactions were trialled
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Marginal = 11.73% Conditional = 32.77%
Confidence comments	Moderate. Dunn Smyth residual tests indicated significant deviance from uniformity, with residuals slightly smaller than expected for a central portion of the range. Outlier test significant identified approximately 20 outliers, most of which were for large values

Model results summary 1: tree growth rate by tree size

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## growth.per.year ~ diameter.first.m * Site quality + diameter.first.m *
##     Treatment + (1 | fsiteplot) + (1 | fsite)
##    Data: dat
##
## REML criterion at convergence: 9164.4
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.1369 -0.6207 -0.0283  0.5739  4.2752
##
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  fsiteplot (Intercept) 1.103    1.050
##  fsite     (Intercept) 1.029    1.015
##  Residual              6.813    2.610
## Number of obs: 1901, groups:  fsiteplot, 66; fsite, 22
##
## Fixed effects:
##                                       Estimate Std. Error        df t value
## (Intercept)                             4.5068     0.5221   77.0797   8.632
## diameter.first.m                        0.2946     0.5940 1854.5258   0.496
## Site qualitySQ2                        -1.7385     0.6083   37.2975  -2.858
## TreatmentMod - Flood                    0.7338     0.6546  197.1809   1.121
## TreatmentFlood - Mod                    2.4234     0.6557  194.1694   3.696
## TreatmentHeavy - Flood                  1.5386     0.6632  201.8874   2.320
## TreatmentFlood - Heavy                  3.0036     0.6555  192.0522   4.582
## diameter.first.m:Site qualitySQ2       -0.3855     0.6205 1860.8221  -0.621
## diameter.first.m:TreatmentMod - Flood  -0.5823     0.8942 1857.1444  -0.651
## diameter.first.m:TreatmentFlood - Mod  -3.4499     0.9191 1860.0505  -3.754
## diameter.first.m:TreatmentHeavy - Flood -2.8380    0.9128 1875.3159  -3.109
## diameter.first.m:TreatmentFlood - Heavy -4.8433    0.9534 1871.4947  -5.080
##                                        Pr(>|t|)
## (Intercept)                            6.10e-13 ***
## diameter.first.m                       0.619968
## Site qualitySQ2                        0.006936 **
## TreatmentMod - Flood                   0.263633
## TreatmentFlood - Mod                   0.000285 ***
## TreatmentHeavy - Flood                 0.021340 *
## TreatmentFlood - Heavy                 8.27e-06 ***
## diameter.first.m:Site qualitySQ2       0.534445
## diameter.first.m:TreatmentMod - Flood  0.515037
## diameter.first.m:TreatmentFlood - Mod  0.000180 ***
## diameter.first.m:TreatmentHeavy - Flood 0.001906 **
## diameter.first.m:TreatmentFlood - Heavy 4.15e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

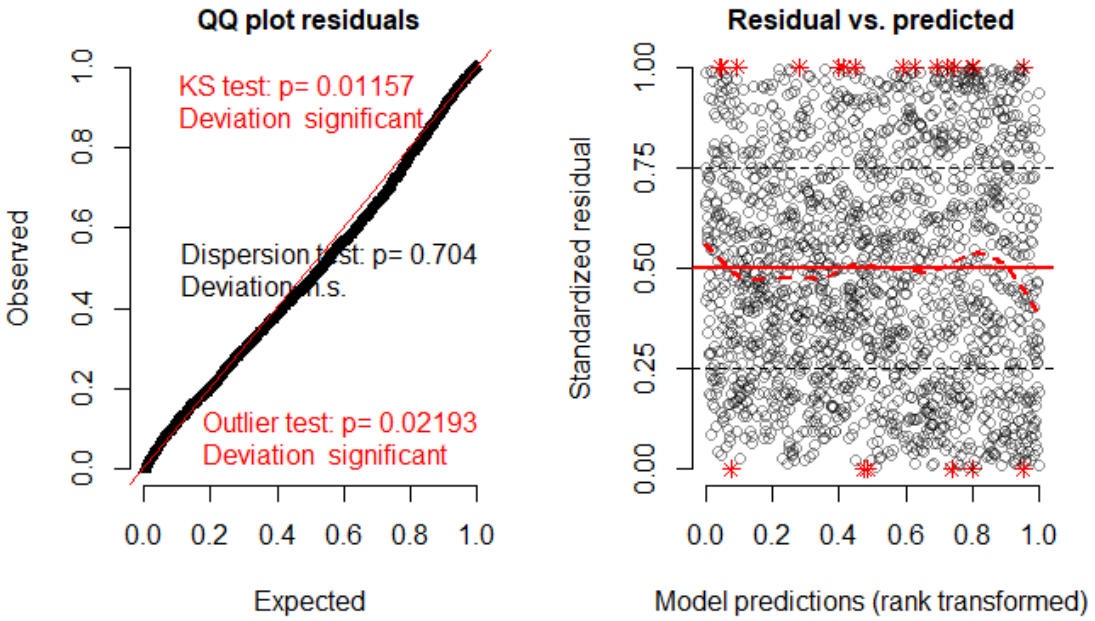


Figure 1 **Dunn Smyth simulated residuals: tree growth rate by tree size**

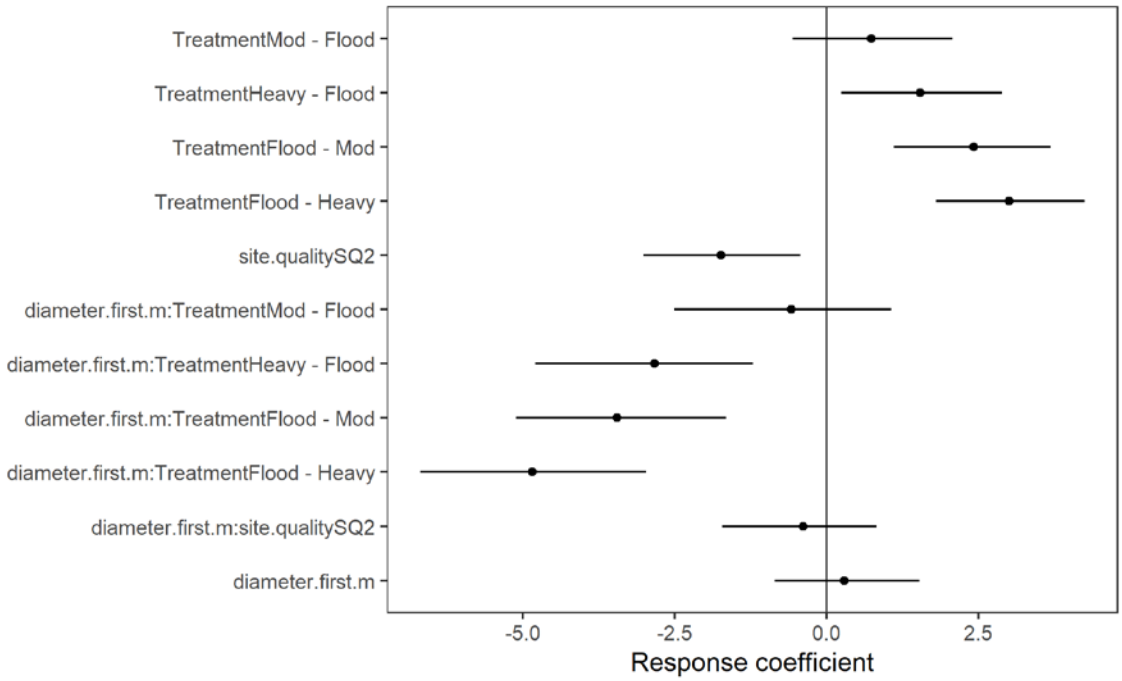


Figure 2 **Bootstrapped confidence intervals for fixed effects: tree growth rate by tree size**

Table 2 **Bootstrapped model fitted values for average conditions: tree growth rate by tree size**

Initial diameter	Site quality	Control	Moderately thinned then flooded	Heavily thinned then flooded	Flooded then moderately thinned	Flooded then heavily thinned
20 cm	SQ1	4.7435	5.3395	5.5360	6.1929	6.7656
80 cm	SQ1	4.6997	5.0888	4.0926	4.4939	3.9193
20 cm	SQ2	2.5929	3.3391	3.6847	4.5690	4.6901
80 cm	SQ2	2.6395	2.7991	1.9365	2.3967	1.8777

B.2 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
Other transformations compared	None
R package and function	glmer from lme4
Distribution used	Binomial
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2) Also ran a model with the order of flooding and thinning included, which was not significant
Fixed factor interactions	Interaction between thinning treatment and survey year Also trialled a three-way interaction between thinning treatment, survey year and site quality, which was less parsimonious
Random factors	site (a factor over sites), and siteplot (a factor over 9 ha treatment plots)
R^2	Marginal = 1.16% Conditional = 9.15%
Confidence comments	Moderate, no deviations detected but R^2 values low

Model results summary 2: tree mortality

```
y <- cbind(success = DAT.livedead$dead, failure = DAT.livedead$live)

model2 <- glmer(y ~ year * Treatment + Site quality + (1|siteplot) + (1|site),
              data = DAT.livedead, family = binomial,
              control=glmerControl(optimizer="bobyqa", optCtrl = list(maxfun = 2e5
)))

summary(model2)

## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: y ~ year * Treatment + Site quality + (1 | siteplot) + (1 | site)
##    Data: DAT.livedead
## Control: glmerControl(optimizer = "bobyqa", optCtrl = list(maxfun = 2e+05))
##
```

```
##      AIC      BIC   logLik deviance df.resid
##   1163.7   1217.3   -566.8   1133.7      249
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.7608 -0.5635 -0.0569  0.4143  2.7455
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  siteplot (Intercept) 0.19629  0.4430
##  site     (Intercept) 0.09314  0.3052
## Number of obs: 264, groups:  siteplot, 66; site, 22
##
## Fixed effects:
##                             Estimate Std. Error z value Pr(>|z|)
## (Intercept)                -2.45088    0.18285 -13.404   <2e-16 ***
## year2017                   -0.17829    0.15868  -1.124   0.2612
## year2018                   -0.03614    0.15406  -0.235   0.8145
## year2019                   -0.11167    0.15645  -0.714   0.4754
## TreatmentModerate           0.06409    0.20358   0.315   0.7529
## TreatmentHeavy              0.05958    0.20382   0.292   0.7701
## Site qualitySQ2            -0.06881    0.18118  -0.380   0.7041
## year2017:TreatmentModerate  0.53195    0.21183   2.511   0.0120 *
## year2018:TreatmentModerate  0.30047    0.20974   1.433   0.1520
## year2019:TreatmentModerate  0.34803    0.21195   1.642   0.1006
## year2017:TreatmentHeavy     0.33764    0.21535   1.568   0.1169
## year2018:TreatmentHeavy     0.34763    0.20948   1.660   0.0970 .
## year2019:TreatmentHeavy     0.44105    0.21098   2.091   0.0366 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

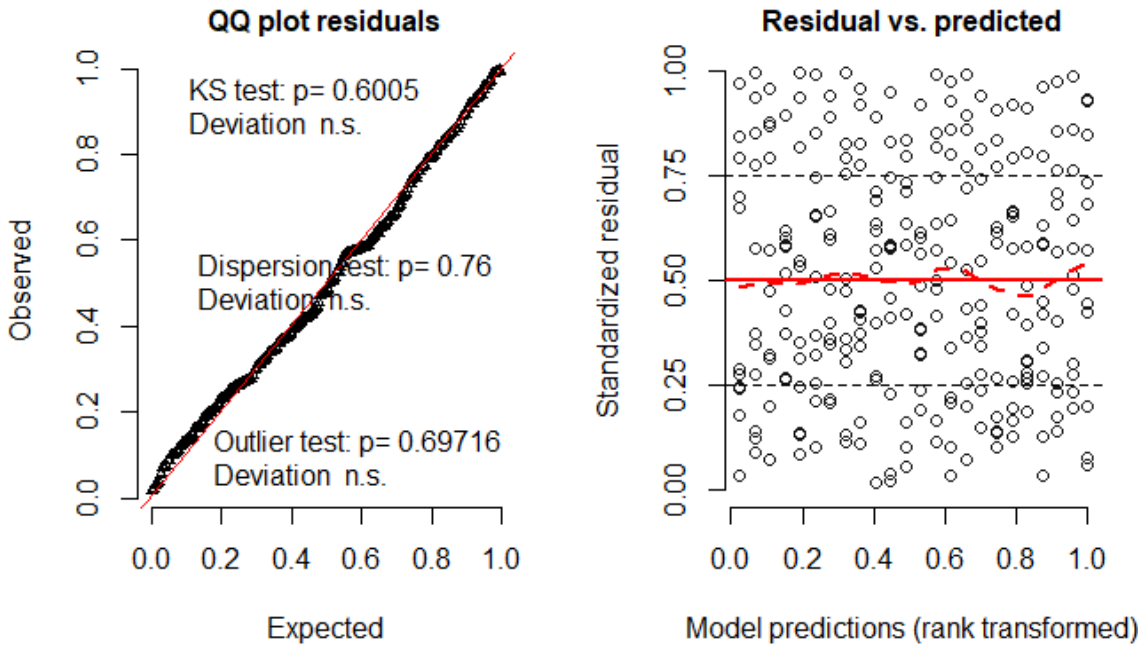


Figure 3 Dunn Smyth simulated residuals: tree mortality

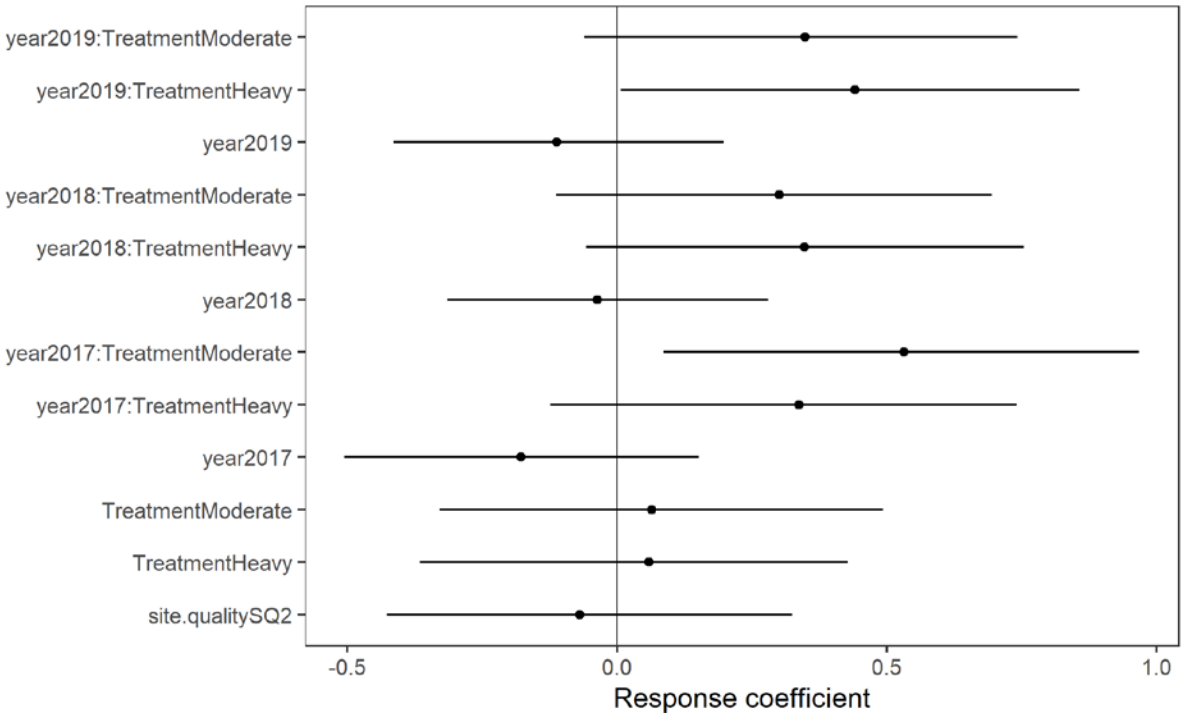


Figure 4 **Bootstrapped confidence intervals for fixed effects: tree mortality**

Table 4 **Bootstrapped model fitted values for average conditions: tree mortality (proportion of trees that were dead)**

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	0.0793	0.0809	0.0841
2017	SQ1	0.0652	0.1122	0.1017
2018	SQ1	0.0764	0.1079	0.1074
2019	SQ1	0.0718	0.1082	0.1135
2015	SQ2	0.0786	0.0748	0.0744
2017	SQ2	0.0650	0.1041	0.0868
2018	SQ2	0.0751	0.1039	0.1027
2019	SQ2	0.0651	0.0961	0.1098

Appendix C: Model summaries – Recruitment

C.1 Germinants

C.1.1 Germinant presence–absence

Table 5 Model fitting summary: germinant presence–absence

Response	Probability of germinants occurring on 9 hectare plot
Response transformation	None
Other transformations compared	None
R package and function	glmer function from lme4 package
Distribution used	Binomial
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Interaction between thinning treatment and survey year Also trialled a model with three-way interaction between thinning treatment, survey year and site quality, which failed to complete due to insufficient data
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Marginal = 27.2% Conditional = 60.1%
Confidence comments	Moderate to high, with some mid values having larger residuals than expected; and some low values having lower residuals than expected. No assumptions violated

Model results summary 3: germinant presence–absence

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: germ.pres ~ Survey year * Treatment + Site quality + (1 | fsite)
##    Data: dat
## Control: glmerControl(optimizer = "bobyqa", optCtrl = list(maxfun = 1e+05))

##      AIC      BIC   logLik deviance df.resid
##    239.2    289.3   -105.6    211.2      250

## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.8465 -0.3688 -0.1894 -0.0837  4.5716

## Random effects:
##  Groups Name        Variance Std.Dev.
##  fsite  (Intercept) 2.712    1.647
## Number of obs: 264, groups:  fsite, 22
## Fixed effects:
##                                    Estimate Std. Error z value Pr(>|z|)
## (Intercept)                      -1.757e+00  9.047e-01  -1.942  0.05213 .
## Survey year2017                   1.281e+00  9.523e-01   1.345  0.17850
## Survey year2018                   9.031e-01  9.657e-01   0.935  0.34970
## Survey year2019                   1.633e+00  9.456e-01   1.727  0.08416 .
## TreatmentModerate                -2.748e-07  1.031e+00   0.000  1.00000
## TreatmentHeavy                    7.966e-07  1.031e+00   0.000  1.00000
## Site qualitySQ2                  -2.501e+00  9.217e-01  -2.713  0.00666 **
## Survey year2017:TreatmentModerate  1.011e+00  1.326e+00   0.762  0.44578
## Survey year2018:TreatmentModerate  3.781e-01  1.350e+00   0.280  0.77940
## Survey year2019:TreatmentModerate -1.149e+00  1.364e+00  -0.842  0.39987
## Survey year2017:TreatmentHeavy     6.868e-01  1.326e+00   0.518  0.60459
## Survey year2018:TreatmentHeavy    -9.031e-01  1.413e+00  -0.639  0.52261
## Survey year2019:TreatmentHeavy    -1.633e+00  1.399e+00  -1.167  0.24303
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

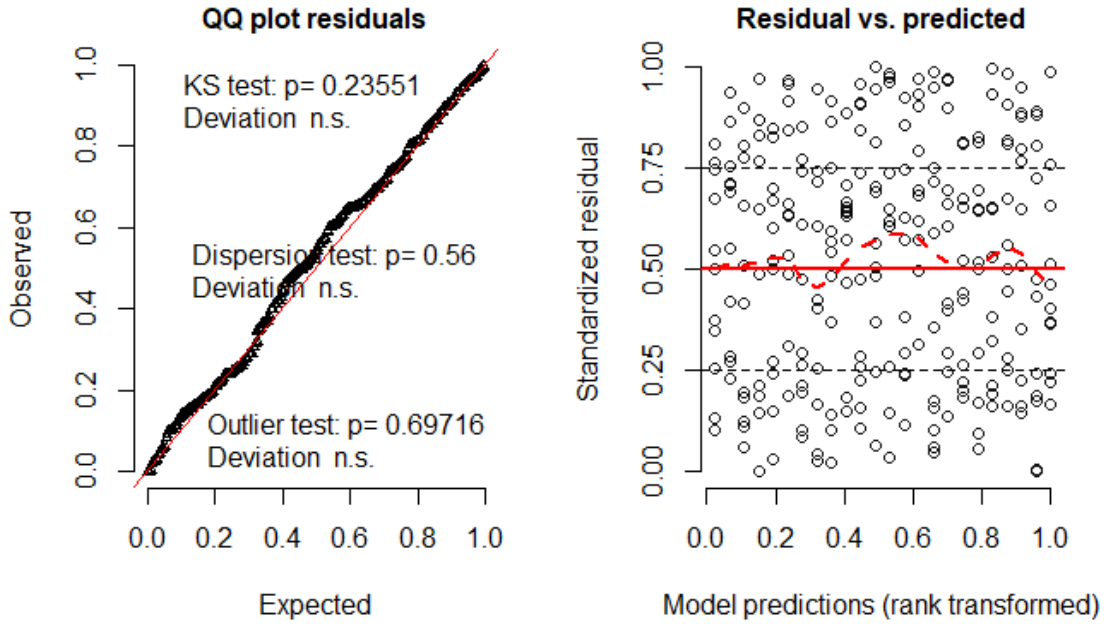


Figure 5 Dunn Smyth simulated residuals: germinant presence–absence

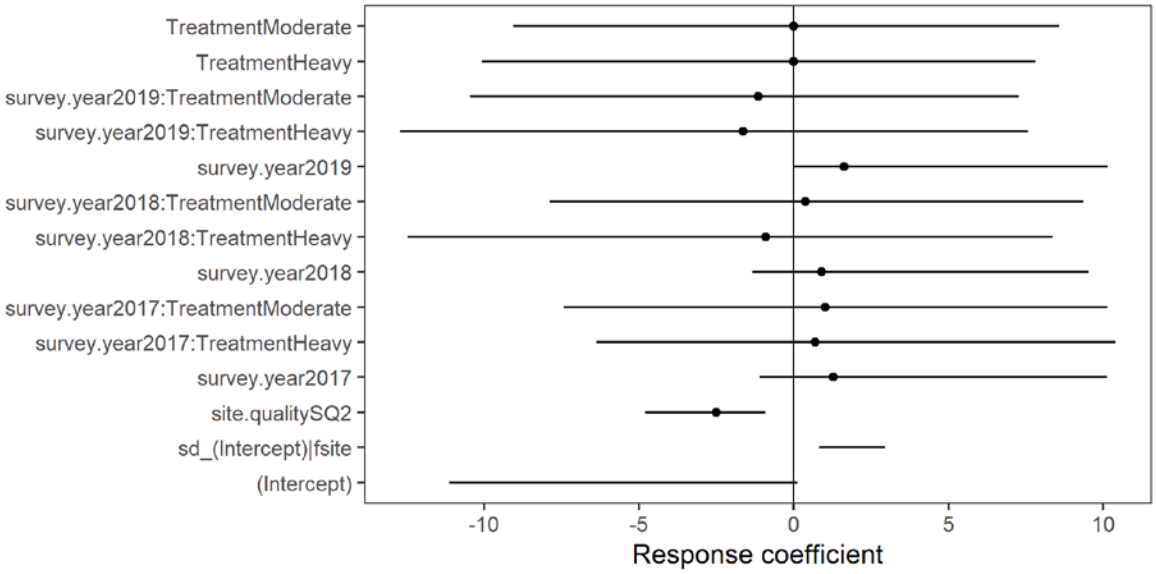


Figure 6 **Bootstrapped confidence intervals for fixed effects: germinant presence–absence**

Table 6 **Bootstrapped fitted values for average conditions: germinant presence–absence (probability of germinants occurring per 9 hectare plot)**

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	0.1358	0.1413	0.1522
2017	SQ1	0.3933	0.6420	0.5564
2018	SQ1	0.2894	0.3837	0.1574
2019	SQ1	0.4643	0.2191	0.1430
2015	SQ2	0.0129	0.0143	0.0132
2017	SQ2	0.0483	0.1199	0.0915
2018	SQ2	0.0350	0.0451	0.0148
2019	SQ2	0.0696	0.0219	0.0134

C.1.2 Germinant abundance

Not modelled.

C.2 Seedlings

C.2.1 Seedling presence–absence

Not modelled.

C.2.2 Seedling abundance

Table 7 Model fitting summary: seedling abundance

Response	Number of seedlings present (total of three 0.04 ha subplots)
Response transformation used	Transformed using $\log_e(x + 1)$
Other transformations compared	Square root
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	Negative binomial
Outliers removed	No outliers removed A gaussian model was trialled with values greater than 600 removed
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Trialled interaction between thinning treatment and survey year Trialled a model with no interactions A model with three-way interaction between thinning treatment, survey year and site quality was more parsimonious and detected significant effects
Random factors	fsite (a factor over sites)
R^2	Marginal = 10.9% Conditional = 54.9%
Confidence comments	High, no assumptions violated

Model results summary 4: seedling abundance

```
dat$Lseedlings<-log(dat$seedlings+1)
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: Lseedlings ~ Survey year * Treatment * Site quality + (1 | fsite)
##    Data: dat

## REML criterion at convergence: 817.2

## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.6128 -0.5228  0.0226  0.5302  4.0757

## Random effects:
##  Groups   Name        Variance Std.Dev.
##  fsite    (Intercept) 1.096    1.047
##  Residual             1.123    1.059
## Number of obs: 264, groups:  fsite, 22

## Fixed effects:
##                                                  Estimate Std. Error
## (Intercept)                                       2.93201    0.44905
## Survey year2017                                   0.34959    0.45177
## Survey year2018                                   0.88134    0.45177
## Survey year2019                                   0.11629    0.45177
## TreatmentModerate                                 0.56219    0.45177
## TreatmentHeavy                                    0.44946    0.45177
## Site qualitySQ2                                   0.05899    0.63505
## Survey year2017:TreatmentModerate                -0.85172    0.63890
## Survey year2018:TreatmentModerate                -1.01485    0.63890
## Survey year2019:TreatmentModerate                 0.19694    0.63890
## Survey year2017:TreatmentHeavy                   -0.11403    0.63890
## Survey year2018:TreatmentHeavy                   -0.52872    0.63890
## Survey year2019:TreatmentHeavy                   -0.32814    0.63890
## Survey year2017:Site qualitySQ2                  -0.47418    0.63890
## Survey year2018:Site qualitySQ2                  -1.47462    0.63890
## Survey year2019:Site qualitySQ2                  -1.31478    0.63890
## TreatmentModerate:Site qualitySQ2                -1.07609    0.63890
## TreatmentHeavy:Site qualitySQ2                   -1.31491    0.63890
## Survey year2017:TreatmentModerate:Site qualitySQ2  1.71851    0.90354
## Survey year2018:TreatmentModerate:Site qualitySQ2  1.87452    0.90354
## Survey year2019:TreatmentModerate:Site qualitySQ2  0.80194    0.90354
## Survey year2017:TreatmentHeavy:Site qualitySQ2     1.31591    0.90354
## Survey year2018:TreatmentHeavy:Site qualitySQ2     1.86054    0.90354
## Survey year2019:TreatmentHeavy:Site qualitySQ2     2.14715    0.90354
##                                                        df t value Pr(>|t|)
## (Intercept)                                         65.15335   6.529 1.16e-08
## Survey year2017                                    220.00001   0.774   0.4399
## Survey year2018                                    220.00001   1.951   0.0523
## Survey year2019                                    220.00001   0.257   0.7971
## TreatmentModerate                                  220.00001   1.244   0.2147
## TreatmentHeavy                                     220.00001   0.995   0.3209
## Site qualitySQ2                                     65.15335   0.093   0.9263
## Survey year2017:TreatmentModerate                  220.00001  -1.333   0.1839
## Survey year2018:TreatmentModerate                  220.00001  -1.588   0.1136
## Survey year2019:TreatmentModerate                  220.00001   0.308   0.7582
## Survey year2017:TreatmentHeavy                     220.00001  -0.178   0.8585
## Survey year2018:TreatmentHeavy                     220.00001  -0.828   0.4088
## Survey year2019:TreatmentHeavy                     220.00001  -0.514   0.6080
## Survey year2017:Site qualitySQ2                    220.00001  -0.742   0.4588
```

```
## Survey year2018:Site qualitySQ2                     220.00001  -2.308   0.0219
## Survey year2019:Site qualitySQ2                     220.00001  -2.058   0.0408
## TreatmentModerate:Site qualitySQ2                   220.00001  -1.684   0.0935
## TreatmentHeavy:Site qualitySQ2                      220.00001  -2.058   0.0408
## Survey year2017:TreatmentModerate:Site qualitySQ2 220.00001   1.902   0.0585
## Survey year2018:TreatmentModerate:Site qualitySQ2 220.00001   2.075   0.0392
## Survey year2019:TreatmentModerate:Site qualitySQ2 220.00001   0.888   0.3758
## Survey year2017:TreatmentHeavy:Site qualitySQ2    220.00001   1.456   0.1467
## Survey year2018:TreatmentHeavy:Site qualitySQ2    220.00001   2.059   0.0407
## Survey year2019:TreatmentHeavy:Site qualitySQ2    220.00001   2.376   0.0183
##
## (Intercept)                                       ***
## Survey year2017
## Survey year2018                                   .
## Survey year2019
## TreatmentModerate
## TreatmentHeavy
## Site qualitySQ2
## Survey year2017:TreatmentModerate
## Survey year2018:TreatmentModerate
## Survey year2019:TreatmentModerate
## Survey year2017:TreatmentHeavy
## Survey year2018:TreatmentHeavy
## Survey year2019:TreatmentHeavy
## Survey year2017:Site qualitySQ2
## Survey year2018:Site qualitySQ2                   *
## Survey year2019:Site qualitySQ2                   *
## TreatmentModerate:Site qualitySQ2                 .
## TreatmentHeavy:Site qualitySQ2                    *
## Survey year2017:TreatmentModerate:Site qualitySQ2 .
## Survey year2018:TreatmentModerate:Site qualitySQ2 *
## Survey year2019:TreatmentModerate:Site qualitySQ2
## Survey year2017:TreatmentHeavy:Site qualitySQ2
## Survey year2018:TreatmentHeavy:Site qualitySQ2    *
## Survey year2019:TreatmentHeavy:Site qualitySQ2    *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

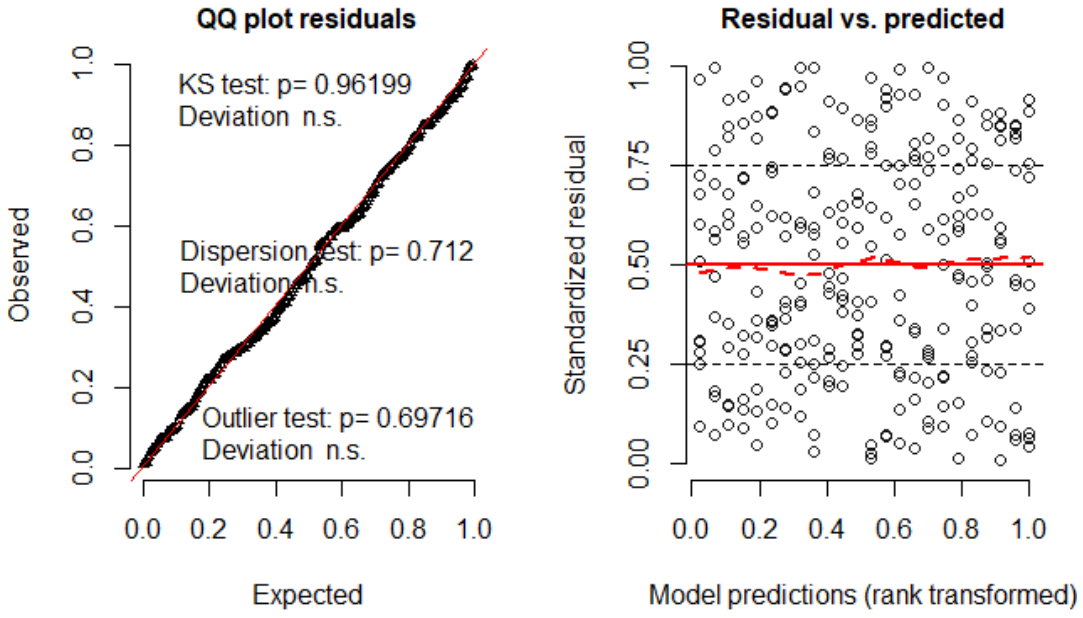


Figure 7 Dunn Smyth simulated residuals: seedling abundance

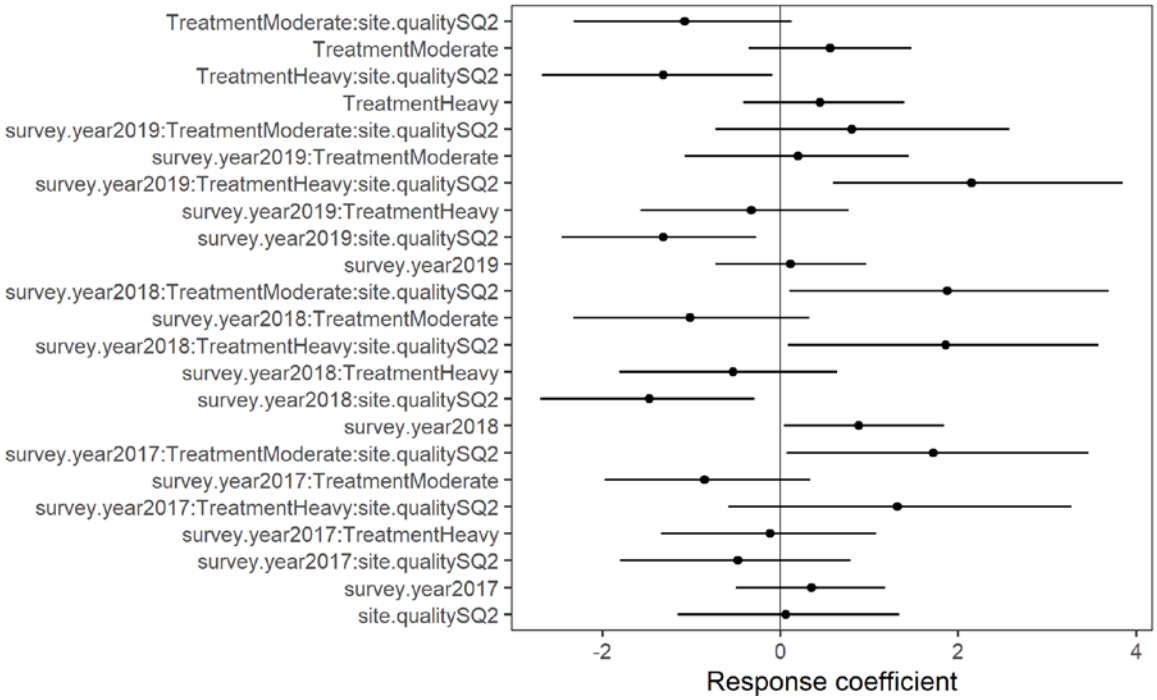


Figure 8 Bootstrapped confidence intervals for fixed effects: seedling abundance

Table 8 Bootstrapped fitted values for average conditions: seedling abundance

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	17.2718	32.9701	28.4781
2017	SQ1	26.9601	19.9246	37.0526
2018	SQ1	46.3531	28.8572	42.3082
2019	SQ1	20.4866	45.4674	23.5706
2015	SQ2	17.8609	10.6769	7.7861
2017	SQ2	16.3969	25.8775	23.3185
2018	SQ2	10.3936	13.8200	17.3604
2019	SQ2	4.7678	8.4469	14.3858

C.3 Saplings

C.3.1 Sapling presence–absence

Not modelled.

C.3.2 Sapling abundance

Table 9 Model fitting summary: sapling abundance

Response	Total number of saplings recorded in three 0.04 ha subplots in each 9 ha plot
Response transformation used	$Log_e(x + 1)$
Other transformations compared	Square root was considered (histogram of square root of sapling abundance was inspected) but model was not run
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	Negative binomial
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year Also trialled a model with three-way interaction between thinning treatment, survey year and site quality, which was less parsimonious
Random factors	fsite (a factor over sites)
R^2	Marginal = 31.9% Conditional = 66.1%
Confidence comments	Moderate. The normal QQ plot (not the Dunn Smyth simulated residuals shown below) indicates larger than expected residuals for large values

Model results summary 5: sapling abundance

```
dat$Lsaplings<-log(dat$saplings +1)

model6_log <- lmer(Lsaplings ~ Survey year*Treatment + Site quality + (1 | fsite),
                           data = dat)

summary(model6_log)

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: Lsaplings ~ Survey year * Treatment + Site quality + (1 | fsite)
##    Data: dat
##
## REML criterion at convergence: 727.6
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.5576 -0.4353 -0.0119  0.4712  3.5569
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  fsite    (Intercept) 0.7403   0.8604
##  Residual             0.7345   0.8570
## Number of obs: 264, groups:  fsite, 22
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                         3.988383   0.321667  39  12.399
## Survey year2017                    -0.152453   0.258397 231  -0.590
## Survey year2018                    -0.257070   0.258397 231  -0.995
## Survey year2019                    -0.448996   0.258397 231  -1.738
## TreatmentModerate                  -0.008306   0.258397 231  -0.032
## TreatmentHeavy                     -0.219193   0.258397 231  -0.848
## Site qualitySQ2                    -0.912877   0.381751  19  -2.391
## Survey year2017:TreatmentModerate  -1.228845   0.365428 231  -3.363
## Survey year2018:TreatmentModerate  -1.129331   0.365428 231  -3.090
## Survey year2019:TreatmentModerate  -0.814448   0.365428 231  -2.229
## Survey year2017:TreatmentHeavy     -1.378018   0.365428 231  -3.771
## Survey year2018:TreatmentHeavy     -1.189243   0.365428 231  -3.254
## Survey year2019:TreatmentHeavy     -1.012669   0.365428 231  -2.771
##                                   Pr(>|t|)
## (Intercept)                        3.1e-15 ***
## Survey year2017                   0.555769
## Survey year2018                   0.320843
## Survey year2019                   0.083610 .
## TreatmentModerate                 0.974385
## TreatmentHeavy                    0.397159
## Site qualitySQ2                   0.026734 *
## Survey year2017:TreatmentModerate 0.000903 ***
## Survey year2018:TreatmentModerate 0.002244 **
## Survey year2019:TreatmentModerate 0.026794 *
## Survey year2017:TreatmentHeavy    0.000207 ***
## Survey year2018:TreatmentHeavy    0.001307 **
## Survey year2019:TreatmentHeavy    0.006040 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

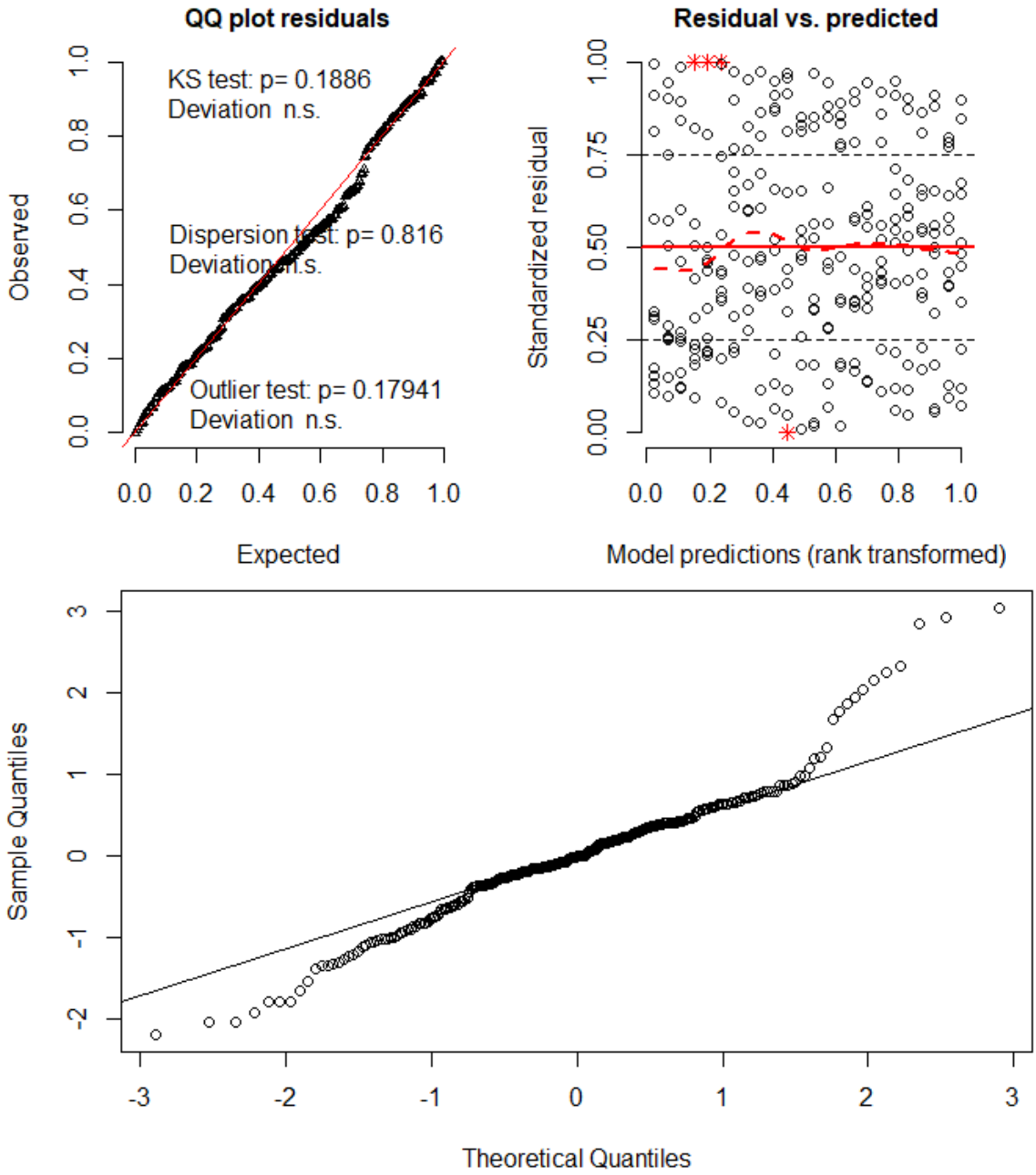


Figure 9 **Dunn Smyth simulated residuals (top panels) and normal QQ plot (bottom pane): sapling abundance**

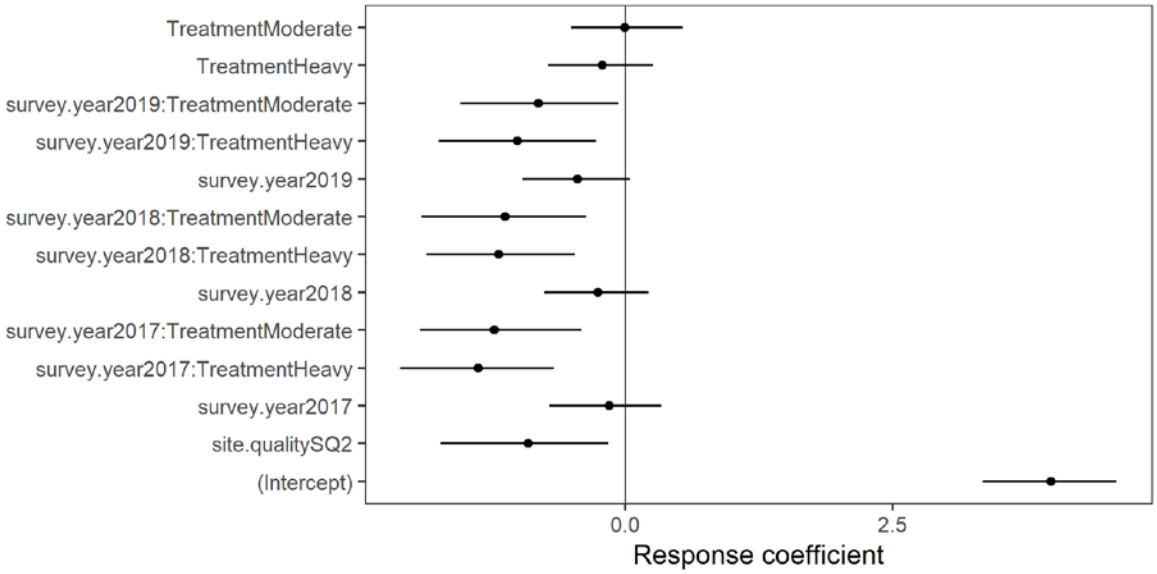


Figure 10 Bootstrapped confidence intervals for fixed effects: sapling abundance

Table 10 Bootstrapped fitted values for average conditions: sapling abundance (total of three 0.04 hectare subplots)

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	52.9491	54.4580	40.6011
2017	SQ1	43.9568	13.1281	8.5304
2018	SQ1	43.6266	12.4474	9.3628
2019	SQ1	33.2792	14.2173	9.4484
2015	SQ2	21.1552	20.9354	16.0500
2017	SQ2	17.1027	4.9699	2.7762
2018	SQ2	15.7366	4.4380	3.3320
2019	SQ2	13.1764	5.1329	3.0101

Appendix D: Model summaries – Canopy condition

D.1 Tree crown extent

D.1.1 Average crown extent

Table 11 Model fitting summary: average crown extent

Response	Average crown extent. Average of crown extent (5% categories) assessed for 30 trees per 9 hectare plot A continuous, positive variable
Response transformations used	None
Response transformations compared	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Trialled a model with a two-way interaction between thinning treatment and survey year and an additive effect of site quality A model with three-way interaction between thinning treatment, survey year and site quality was more parsimonious and detected significant effects
Random effects	fsite (a factor over sites)
R^2	Marginal = 38.1% Conditional = 61.0%
Confidence comments	High. Met all assumptions

Model results summary 6: average crown extent

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: mean_extent ~ year * Treatment * Site quality + (1 | site)
##    Data: dat.time

## REML criterion at convergence: 1279.7

## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.8943 -0.5673  0.0228  0.5061  2.3398

## Random effects:
##  Groups   Name        Variance Std.Dev.
##  site     (Intercept) 4.714    2.171
##  Residual             8.009    2.830
## Number of obs: 264, groups:  site, 22

## Fixed effects:
##                                            Estimate Std. Error  df
## (Intercept)                                76.93156    1.07548  95
## year2017                                    4.82602    1.20676 220
## year2018                                    3.90178    1.20676 220
## year2019                                    5.20481    1.20676 220
## TreatmentModerate                           2.16353    1.20676 220
## TreatmentHeavy                             -1.49142    1.20676 220
## Site qualitySQ2                            -2.74974    1.52096  95
## year2017:TreatmentModerate                 -1.11808    1.70662 220
## year2018:TreatmentModerate                 -0.07262    1.70662 220
## year2019:TreatmentModerate                 -0.28474    1.70662 220
## year2017:TreatmentHeavy                     0.87073    1.70662 220
## year2018:TreatmentHeavy                     1.40051    1.70662 220
## year2019:TreatmentHeavy                     0.94596    1.70662 220
## year2017:Site qualitySQ2                    0.29519    1.70662 220
## year2018:Site qualitySQ2                    0.43156    1.70662 220
## year2019:Site qualitySQ2                   -3.47753    1.70662 220
## TreatmentModerate:Site qualitySQ2          -1.69331    1.70662 220
## TreatmentHeavy:Site qualitySQ2              1.13671    1.70662 220
## year2017:TreatmentModerate:Site qualitySQ2  1.33856    2.41352 220
## year2018:TreatmentModerate:Site qualitySQ2  1.16040    2.41352 220
## year2019:TreatmentModerate:Site qualitySQ2  4.02665    2.41352 220
## year2017:TreatmentHeavy:Site qualitySQ2    -0.48833    2.41352 220
## year2018:TreatmentHeavy:Site qualitySQ2     0.22692    2.41352 220
## year2019:TreatmentHeavy:Site qualitySQ2     2.84814    2.41352 220
##                                            t value Pr(>|t|)
## (Intercept)                                 71.532  < 2e-16 ***
## year2017                                     3.999 8.68e-05 ***
## year2018                                     3.233  0.00141 **
## year2019                                     4.313 2.43e-05 ***
## TreatmentModerate                            1.793  0.07437 .
## TreatmentHeavy                              -1.236  0.21782
## Site qualitySQ2                             -1.808  0.07377 .
## year2017:TreatmentModerate                  -0.655  0.51306
## year2018:TreatmentModerate                  -0.043  0.96610
## year2019:TreatmentModerate                  -0.167  0.86764
## year2017:TreatmentHeavy                      0.510  0.61042
## year2018:TreatmentHeavy                      0.821  0.41274
## year2019:TreatmentHeavy                      0.554  0.57994
## year2017:Site qualitySQ2                     0.173  0.86283
## year2018:Site qualitySQ2                     0.253  0.80060
```

```
## year2019:Site qualitySQ2                        -2.038  0.04278 *
## TreatmentModerate:Site qualitySQ2               -0.992  0.32219
## TreatmentHeavy:Site qualitySQ2                   0.666  0.50607
## year2017:TreatmentModerate:Site qualitySQ2       0.555  0.57973
## year2018:TreatmentModerate:Site qualitySQ2       0.481  0.63114
## year2019:TreatmentModerate:Site qualitySQ2       1.668  0.09667 .
## year2017:TreatmentHeavy:Site qualitySQ2         -0.202  0.83984
## year2018:TreatmentHeavy:Site qualitySQ2          0.094  0.92518
## year2019:TreatmentHeavy:Site qualitySQ2          1.180  0.23924
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

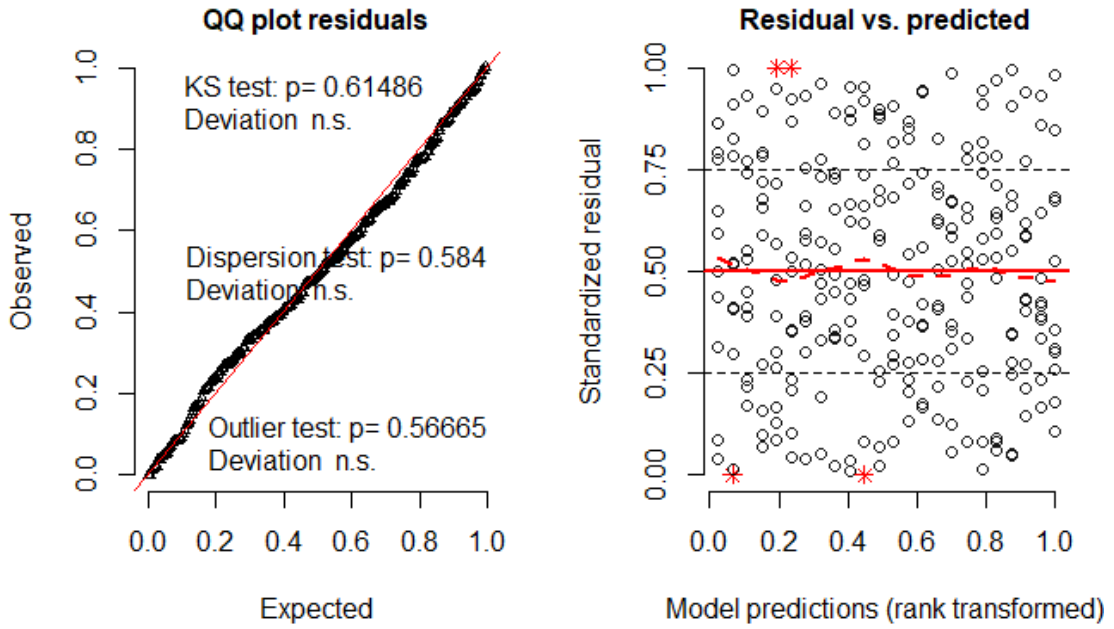


Figure 11 Dunn Smyth simulated residuals: average crown extent

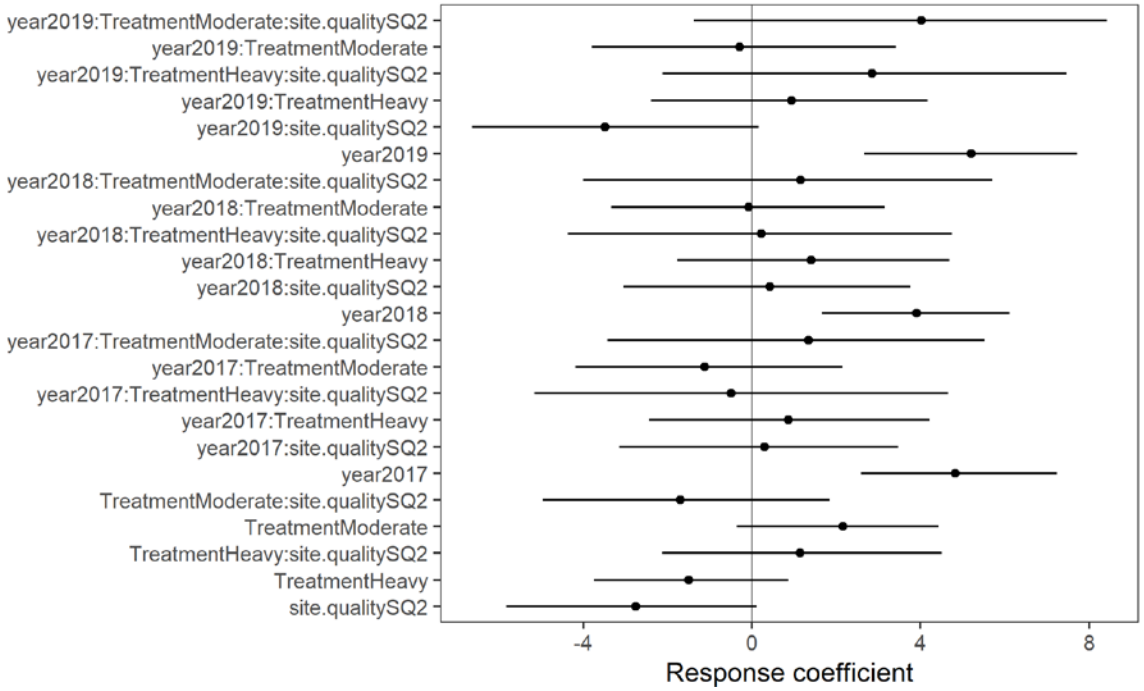


Figure 12 Bootstrapped confidence intervals for fixed effects: average crown extent

Table 12 Bootstrapped fitted values for average conditions: average crown extent

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	77.0392	79.0953	75.2230
2017	SQ1	81.6934	82.7277	80.9850
2018	SQ1	80.8175	82.7698	80.8600
2019	SQ1	81.9851	83.7398	81.5946
2015	SQ2	74.2049	74.5359	73.7595
2017	SQ2	79.4031	79.9347	79.2039
2018	SQ2	78.4629	80.1466	79.7105
2019	SQ2	75.7144	80.1640	79.2886

D.1.2 Proportion of trees with recent crown extent decline

Table 13 Model fitting summary: proportion of trees with recent crown extent decline

Response	Proportion of 30 trees per 9 hectare plot with recent decline (between 2018 and 2019) in crown extent Ratio of trees with decline to trees with stable or increasing crown extent
Response transformations used	None
Response transformations compared	None
R package and function	glmer from the lme4 package
Distribution used	Binomial
Other distributions compared	Negative binomial
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and site quality
Random factors	fsite (a factor over sites)
R^2	Marginal = 8.7% Conditional = 27.0%
Confidence comments	Moderate. Assumptions met but some minor overdispersion apparent

Model results summary 7: proportion of trees with recent decline in crown extent

```
y<-cbind(success = dat.num.trees2$Decline, failure = dat.num.trees2$Notdecline)

model2 <- glmer(y ~ Treatment * Site quality + (1|fsite), data=dat.num.trees2, fam
ily = binomial)

summary(model2)

## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: y ~ Treatment * Site quality + (1 | fsite)
##    Data: dat.num.trees2
##
##      AIC      BIC   logLik deviance df.resid
##    379.6    394.9   -182.8    365.6       59
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.5768 -0.8330 -0.1300  0.8484  3.4002
##
## Random effects:
##  Groups Name        Variance Std.Dev.
##  fsite  (Intercept) 0.8248   0.9082
## Number of obs: 66, groups:  fsite, 22
##
## Fixed effects:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                       -2.3983     0.3382  -7.092 1.32e-12 ***
## TreatmentModerate                  0.3512     0.2408   1.458  0.14471
## TreatmentHeavy                     0.2127     0.2446   0.870  0.38456
## Site qualitySQ2                    1.7875     0.4510   3.964 7.38e-05 ***
## TreatmentModerate:Site qualitySQ2 -1.2517     0.3040  -4.117 3.83e-05 ***
## TreatmentHeavy:Site qualitySQ2    -0.8006     0.3020  -2.651  0.00803 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) TrtmnM TrtmnH st.SQ2 TM:.SQ
## TretmntMdrt -0.397
## TreatmntHvy -0.388  0.538
## sit.qltySQ2 -0.749  0.298  0.291
## TrtmnM:.SQ2  0.316 -0.792 -0.426 -0.339
## TrtmnH:.SQ2  0.315 -0.436 -0.810 -0.339  0.500
```

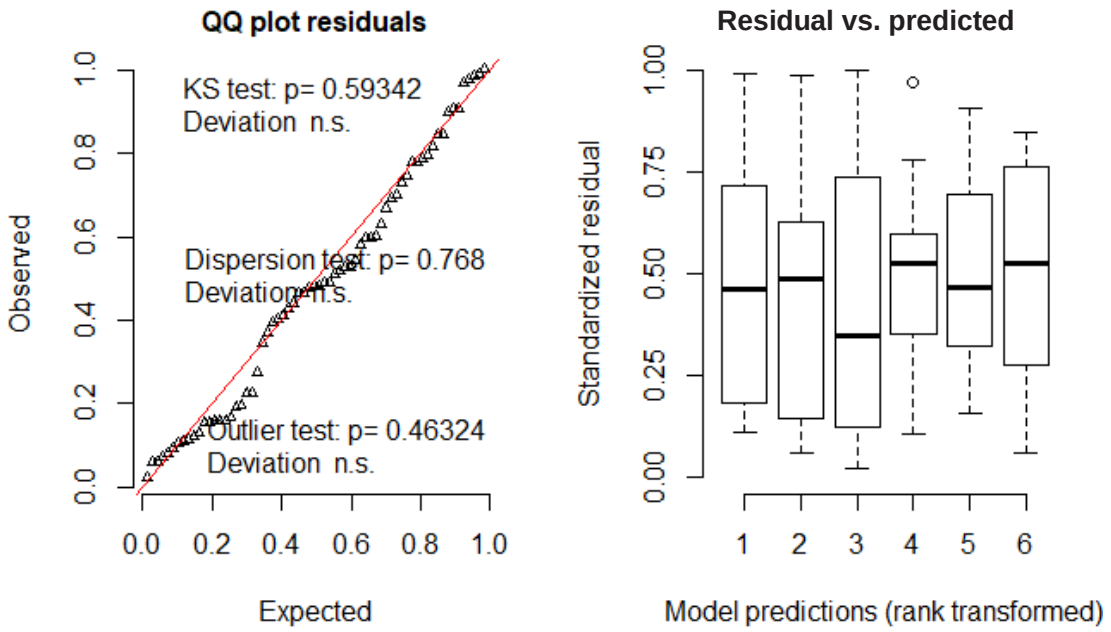


Figure 13 **Dunn Smyth simulated residuals: proportion of trees with recent decline in crown extent**

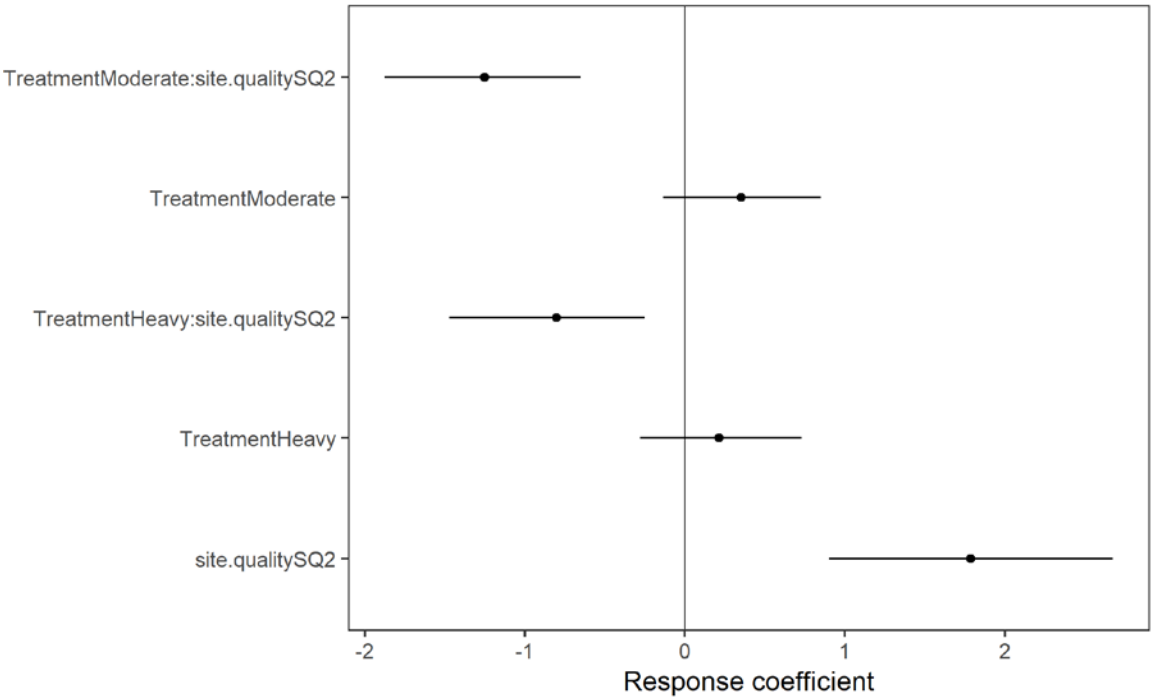


Figure 14 **Bootstrapped confidence intervals for fixed effects: proportion of trees with recent decline in crown extent**

Table 14 **Bootstrapped model fitted values for average conditions: proportion of trees with recent decline in crown extent**

Survey year	Site quality	Control	Moderate	Heavy
2019	SQ1	0.0784	0.1146	0.1021
2019	SQ2	0.3331	0.1833	0.2354

D.1.3 Magnitude of recent crown extent decline

Table 15 Model fitting summary: magnitude of recent crown extent decline

Response	Probability of being in each 5% category of crown extent decline (e.g. category 1 is –5%; category 2 is –10%) Ordinal categorical variable
Response transformations used	None
Response transformations compared	None
R package and function	brm from brms package Note that cumulative ordinal regressions using the clm, clmm, and clmm2 from the ordinal package were attempted but the package was not well-developed enough to be useful
Distribution used	Cumulative with equidistant thresholds
Other distributions compared	Negative binomial, which violated many assumptions
Outliers removed	None
Fixed factor	Ecological thinning treatment (control, moderate, heavy) Site quality
Fixed factor interactions	Two-way interaction between thinning treatment and site quality
Random factor	fsite (a factor over sites) and fsiteplot (a factor over plots nested within sites). Note that most plots had more than one tree with recent decline.
Confidence comments	Moderate

Model results summary 8: magnitude of recent crown extent decline

```
model4_brms_cm <- brm(formula = change_recent_abs_or ~ Site quality * Treatment +
(1|fsite) + (1|fsiteplot),
           data = dat.decline.recent, family = cumulative(threshold = "equidistant
"),
           prior = set_prior("normal(0,1)"), control = list(adapt_delta = 0.99))


summary(model4_brms_cm)

##  Family: cumulative
##   Links: mu = logit; disc = identity
## Formula: change_recent_abs_or ~ Site quality * Treatment + (1 | fsite) + (1 | f
siteplot)
##    Data: dat.decline.recent (Number of observations: 2045)
## Samples: 4 chains, each with iter = 2000; warmup = 1000; thin = 1;
##          total post-warmup samples = 4000
##
## Group-Level Effects:
## ~fsite (Number of levels: 21)
```

```
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     1.12      0.37     0.51     1.98 1.00     1292     1281
##
## ~fsiteplot (Number of levels: 61)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.83      0.20     0.50     1.27 1.00     1032     1708
##
## Population-Level Effects:
##                                   Estimate Est.Error l-95% CI u-95% CI Rhat
## Intercept[1]                          1.92      0.47     1.05     2.87 1.00
## Intercept[2]                          2.48      0.47     1.62     3.43 1.00
## Intercept[3]                          3.04      0.47     2.17     4.00 1.00
## Intercept[4]                          3.60      0.48     2.73     4.57 1.00
## Intercept[5]                          4.16      0.48     3.28     5.14 1.00
## Intercept[6]                          4.72      0.48     3.83     5.71 1.00
## Intercept[7]                          5.29      0.49     4.38     6.27 1.00
## Intercept[8]                          5.85      0.50     4.92     6.84 1.00
## Intercept[9]                          6.41      0.50     5.47     7.41 1.00
## Intercept[10]                         6.97      0.51     6.01     7.97 1.00
## Intercept[11]                         7.53      0.52     6.56     8.55 1.00
## Intercept[12]                         8.09      0.53     7.10     9.11 1.00
## Site qualitySQ2                       0.56      0.55    -0.52     1.64 1.00
## TreatmentModerate                    -0.12      0.42    -0.94     0.69 1.00
## TreatmentHeavy                        0.21      0.41    -0.61     0.98 1.00
## Site qualitySQ2:TreatmentModerate    -0.51      0.50    -1.51     0.52 1.00
## Site qualitySQ2:TreatmentHeavy       -0.73      0.52    -1.73     0.29 1.00
##                                   Bulk_ESS Tail_ESS
## Intercept[1]                          2927     3115
## Intercept[2]                          2932     3080
## Intercept[3]                          2945     3064
## Intercept[4]                          2969     3219
## Intercept[5]                          2997     3114
## Intercept[6]                          3036     3038
## Intercept[7]                          3085     3197
## Intercept[8]                          3139     3144
## Intercept[9]                          3198     3279
## Intercept[10]                         3269     3266
## Intercept[11]                         3341     3085
## Intercept[12]                         3420     2999
## Site qualitySQ2                       2737     2774
## TreatmentModerate                     3444     3018
## TreatmentHeavy                        3068     2924
## Site qualitySQ2:TreatmentModerate     3306     3259
## Site qualitySQ2:TreatmentHeavy        2826     3013
##
## Family Specific Parameters:
##       Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## delta     0.56      0.02     0.52     0.60 1.00     9487     2865
##
## Samples were drawn using sampling(NUTS). For each parameter, Bulk_ESS
## and Tail_ESS are effective sample size measures, and Rhat is the potential
## scale reduction factor on split chains (at convergence, Rhat = 1).
```

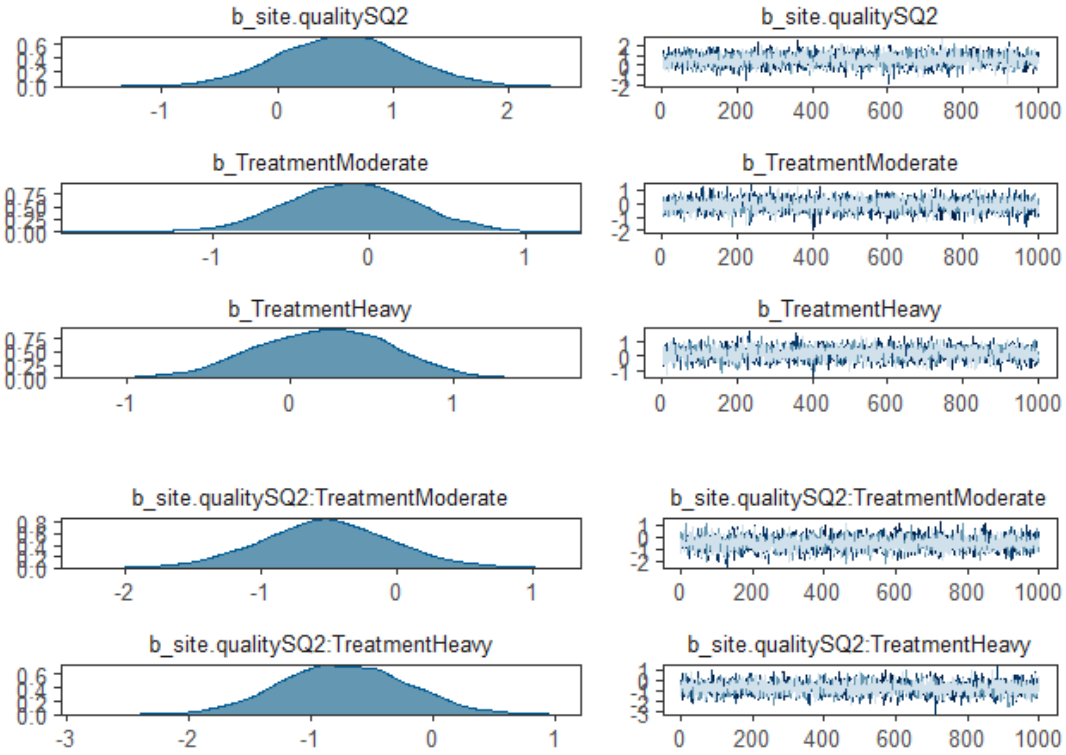


Figure 15 Posterior distributions (left) and chain mixing (right): magnitude of recent crown extent decline

D.2 Visually assessed canopy cover

D.2.1 Live canopy cover

Table 16 Model fitting summary: visually assessed live canopy cover

Response	Visually assessed canopy cover A continuous positive variable
Response transformations used	Divided by 100
Response transformations compared	Log_e was trialled with a gaussian family (see distributions compared below)
R package and function	glmmTMB from the glmmTMB package
Distribution used	Beta
Other distributions compared	Gaussian (with a log transformation of the response) – failed Dunn Smyth tests Binomial – failed Dunn Smyth tests
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Also trialled a model with a two-way interaction between thinning treatment and survey year A model with a three-way interaction between thinning treatment, survey year and site quality was the most parsimonious
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Function not available to calculate R^2 for beta family
Confidence comments	Moderate to high. Standard QQ plot indicated some larger residuals than expected for higher values of the response, but passed all Dunn Smyth tests

Model results summary 9: visually assessed live canopy cover

```
Family: beta  ( logit )
Formula:          cover.live/100 ~ Survey year * Site quality * Treatment + (1 |      fsite
) + (1 | fsiteplot)
Data: DAT.treecover

     AIC      BIC   logLik deviance df.resid
 -2842.8  -2716.7   1448.4  -2896.8      761

Random effects:

Conditional model:
 Groups    Name        Variance Std.Dev.
 fsite     (Intercept) 0.006142 0.07837
 fsiteplot (Intercept) 0.053380 0.23104
Number of obs: 788, groups:  fsite, 22; fsiteplot, 66
Overdispersion parameter for beta family (): 47.3

Conditional model:
                                                Estimate Std. Error z value Pr(>|z|)
(Intercept)                                     -1.93554    0.10659 -18.158  < 2e-16 ***
Survey year2017                                 -0.12353    0.10893  -1.134   0.2568
Survey year2018                                 -0.22946    0.11023  -2.082   0.0374 *
Survey year2019                                 -0.67622    0.12197  -5.544 2.96e-08 ***
Site qualitySQ2                                 -0.27864    0.15333  -1.817   0.0692 .
TreatmentModerate                                0.14749    0.14360   1.027   0.3044
TreatmentHeavy                                  -0.12159    0.14583  -0.834   0.4044
Survey year2017:Site qualitySQ2                  0.32574    0.15607   2.087   0.0369 *
Survey year2018:Site qualitySQ2                  0.14811    0.16081   0.921   0.3571
Survey year2019:Site qualitySQ2                 -0.22088    0.18415  -1.199   0.2304
Survey year2017:TreatmentModerate               -0.35419    0.15445  -2.293   0.0218 *
Survey year2018:TreatmentModerate               -0.26230    0.15492  -1.693   0.0904 .
Survey year2019:TreatmentModerate               -0.10272    0.16758  -0.613   0.5399
Survey year2017:TreatmentHeavy                  -0.21603    0.15704  -1.376   0.1689
Survey year2018:TreatmentHeavy                  -0.17596    0.15893  -1.107   0.2682
Survey year2019:TreatmentHeavy                  -0.30503    0.17934  -1.701   0.0890 .
Site qualitySQ2:TreatmentModerate               -0.16035    0.20897  -0.767   0.4429
Site qualitySQ2:TreatmentHeavy                  -0.08018    0.21300  -0.376   0.7066
Survey year2017:Site qualitySQ2:TreatmentModerate  0.02747    0.22397   0.123   0.9024
Survey year2018:Site qualitySQ2:TreatmentModerate  0.15225    0.22775   0.668   0.5038
Survey year2019:Site qualitySQ2:TreatmentModerate  0.32864    0.25361   1.296   0.1950
Survey year2017:Site qualitySQ2:TreatmentHeavy  -0.12658    0.23073  -0.549   0.5833
Survey year2018:Site qualitySQ2:TreatmentHeavy   0.04586    0.23533   0.195   0.8455
Survey year2019:Site qualitySQ2:TreatmentHeavy   0.56076    0.26583   2.109   0.0349 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

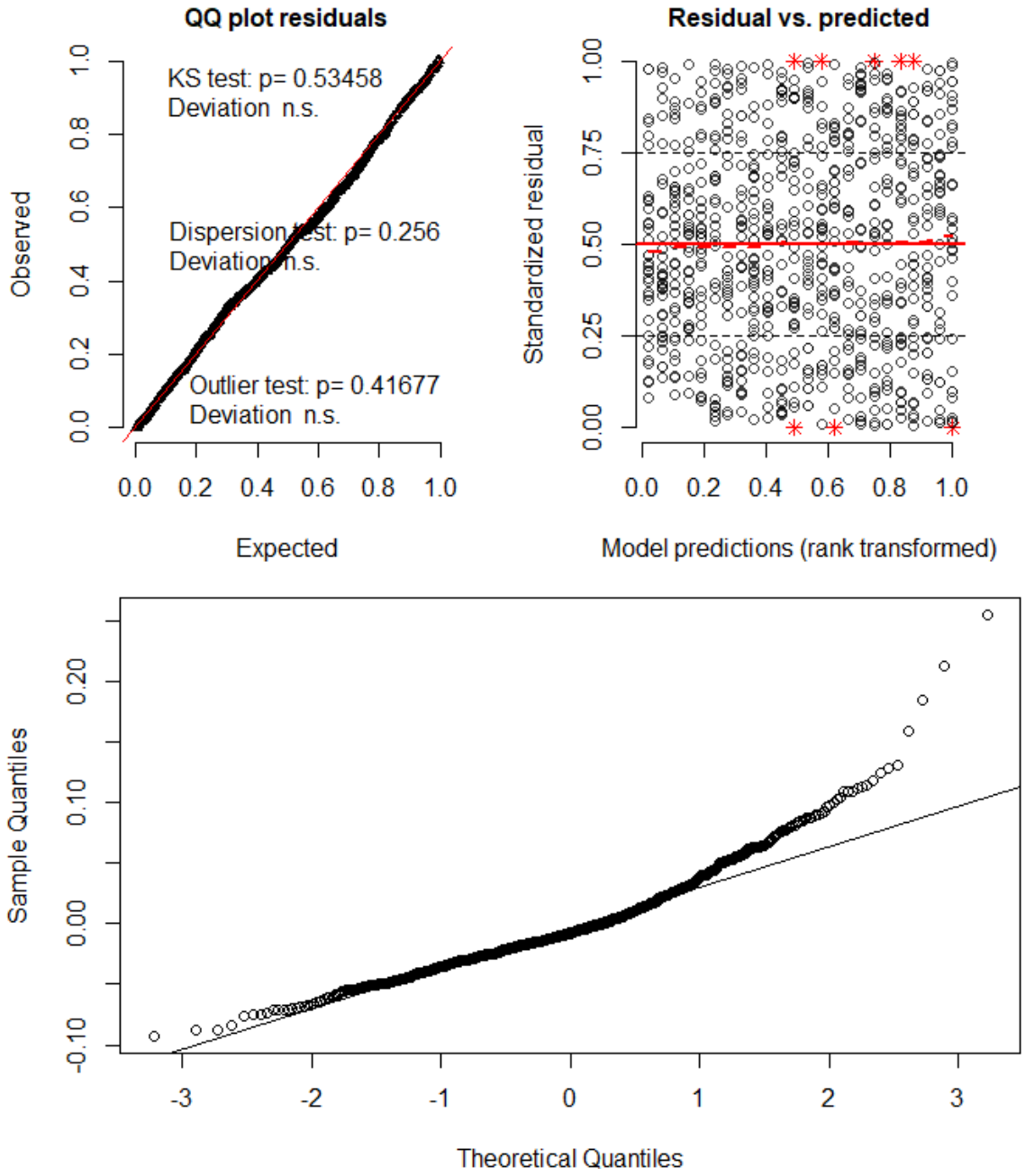


Figure 16 Dunn Smyth simulated residuals (top panels) and normal QQ plot (lower panel): visually assessed live canopy cover

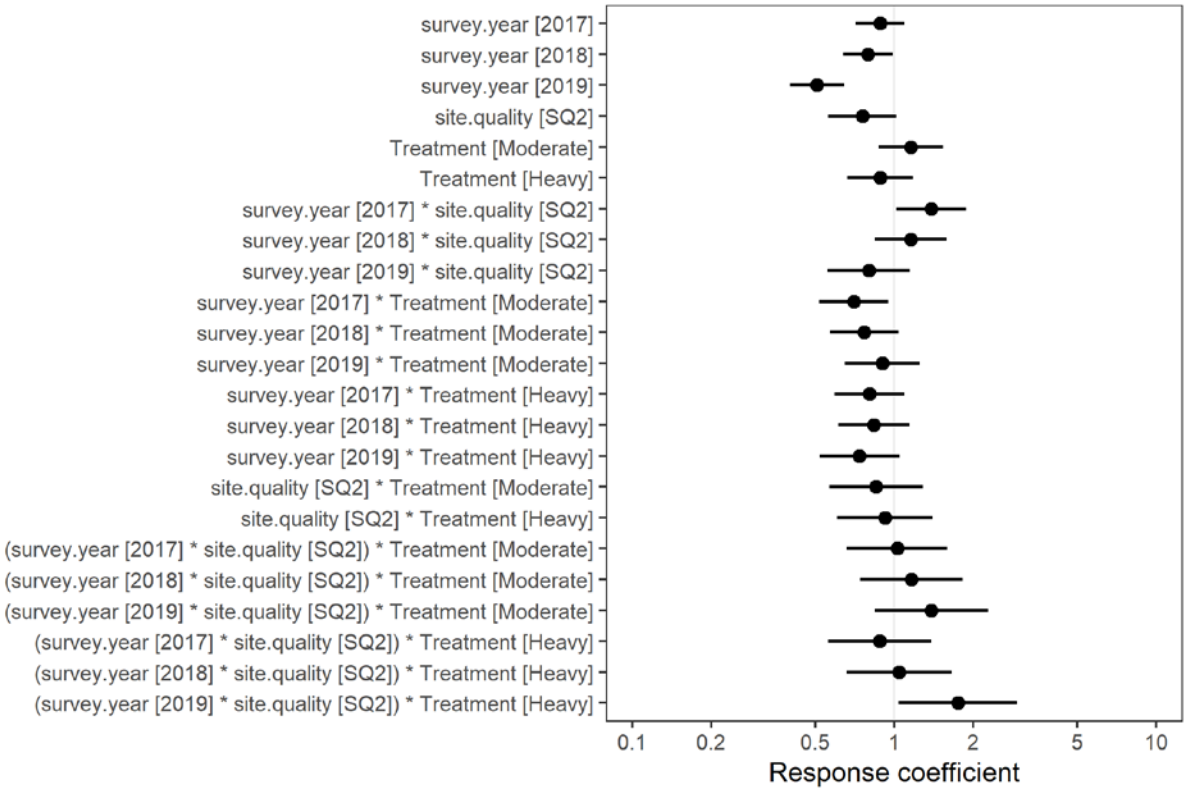


Figure 17 Wald confidence intervals for fixed effects: visually assessed live canopy cover

Table 17 Model fitted values for average conditions: visually assessed live canopy cover

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	12.6939	14.4203	11.4063
2017	SQ1	11.3868	9.4616	8.3980
2018	SQ1	10.3608	9.3420	7.9051
2019	SQ1	6.8848	7.1774	4.6038
2015	SQ2	9.9129	9.7986	8.2511
2017	SQ2	11.8707	8.7519	7.2486
2018	SQ2	9.2097	8.2321	6.7851
2019	SQ2	4.2941	5.2601	4.5214

D.2.2 Dead canopy cover

No model was run because there is no ecological difference between 0.5% dead and 1% dead canopy cover.

D.3 Remotely sensed canopy cover

Table 18 Model fitting summary: remotely sensed foliage projective cover

Response	Foliage projective cover (derived from Landsat images), median of up to 9 values per 9 hectare plot
Response transformation used	Logit
Other transformations compared	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning Site quality (SQ1, SQ2) Pass (of Landsat satellite, approximately every 16 days) CosTime (to represent seasonality) River flow maximum (megalitres per day) from Yarrawonga in the previous year
Fixed factor interactions	Two-way interaction between thinning treatment and site quality
Random factors	A factor over 9 ha treatment plots A spherical correlation structure to account for autocorrelation among plots over time
R^2	Marginal = 52.7% Conditional = 72.6%
Confidence comments	Moderate to high. Dunn Smyth residual tests were not able to be run on a model with autocorrelation. Normal QQ plots and standardised residuals show some deviation from expected behaviour for highest and lowest values. No model violations detected

Model results summary 10: remotely sensed foliage projective cover

```
Linear mixed-effects model fit by REML
 Data: p3x
        AIC       BIC   logLik
  -8001.621 -7932.738 4012.811

Random effects:
 Formula: ~1 | f
        (Intercept)   Residual
StdDev:   0.0523178 0.06134366

Correlation Structure: Spherical spatial correlation
 Formula: ~Pass | f
 Parameter estimate(s):
   range
8.758559
Fixed effects: FPC_med ~ Treatment * SQ_mapped + Pass + CosTime + riverflowmax.x
                                  Value  Std.Error   DF    t-value p-value
(Intercept)                    0.8211735 0.04355385 2239  18.854211  0.0000
TreatmentModerate             -0.0247781 0.02386276   60  -1.038358  0.3033
TreatmentHeavy                -0.0861035 0.02386278   60  -3.608274  0.0006
SQ_mappedSQ2                  -0.1096509 0.02386276   60  -4.595062  0.0000
Pass                          -0.0015475 0.00015597 2239  -9.921636  0.0000
CosTime                       -0.0798731 0.00318020 2239 -25.115775  0.0000
riverflowmax.x                 0.0000003 0.00000006 2239   5.088963  0.0000
TreatmentModerate:SQ_mappedSQ2 -0.0137029 0.03374704   60  -0.406049  0.6862
TreatmentHeavy:SQ_mappedSQ2     0.0330160 0.03374706   60   0.978338  0.3318
 Correlation:
                              (Intr) TrtmnM TrtmnH SQ_SQ2 Pass   CosTim rvrfl. TM:SQ_
TreatmentModerate             -0.274
TreatmentHeavy                -0.274  0.500
SQ_mappedSQ2                  -0.274  0.500  0.500
Pass                          -0.921  0.000  0.000  0.000
CosTime                       -0.093  0.000  0.000  0.000  0.083
riverflowmax.x                -0.521  0.000  0.000  0.000  0.527  0.258
TreatmentModerate:SQ_mappedSQ2  0.194 -0.707 -0.354 -0.707  0.000  0.000  0.000
TreatmentHeavy:SQ_mappedSQ2     0.194 -0.354 -0.707 -0.707  0.000  0.000  0.000  0.500

Standardised Within-Group Residuals:
        Min          Q1         Med          Q3         Max
-7.72298832 -0.46197102 -0.02630681  0.46251712  3.28337711

Number of Observations: 2308
Number of Groups: 66
```

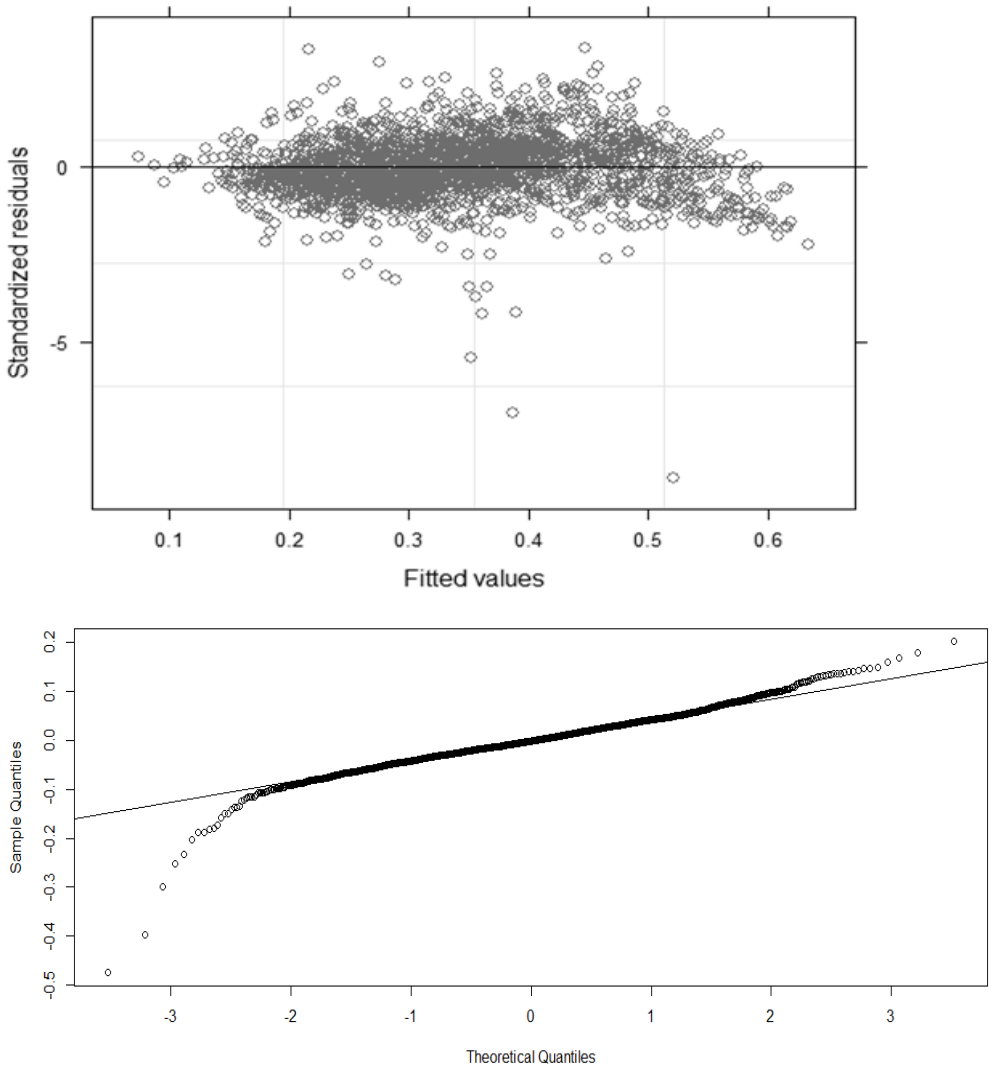


Figure 18 Standardised residuals (top panel) and normal QQ plot (lower panel): remotely sensed foliage projective cover

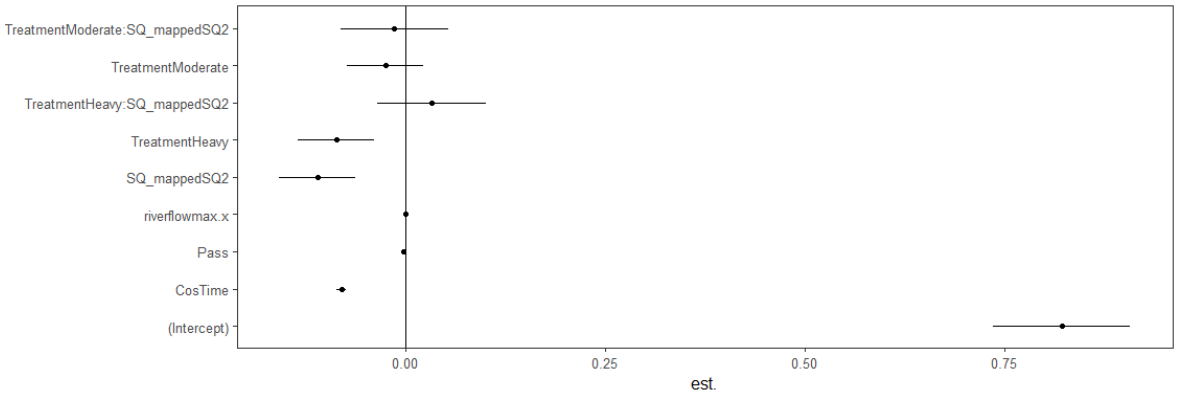


Figure 19 Wald confidence intervals for fixed effects: remotely sensed foliage projective cover

Table 19 Model fitted values for average conditions: remotely sensed foliage projective cover

Survey year	Site quality	Control	Moderate	Heavy
First pass: 2017	SQ1	0.49	0.43	0.40
Most recent pass: 2020	SQ1	0.36	0.35	0.31
First pass: 2017	SQ2	0.39	0.32	0.29
Most recent pass: 2020	SQ2	0.25	0.25	0.21

D.4 Plant area index

Table 20 Model fitting summary: plant area index

Response	Plant area index is the amount of plant material relative to a unit of sky Five estimates were obtained per 9 hectare plot A positive continuous variable
Response transformation used	None
Response transformations compared	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Site quality (SQ1, SQ2)
Fixed factors interactions	Two-way interaction between thinning treatment and site quality
Random factors	site (a factor over sites), and siteplot (a factor over 9 ha treatment plots)
R^2	Marginal = 45.7% Conditional = 72.7%
Confidence comments	High. Passed all Dunn Smyth tests

Model results summary 11: plant area index

```
modelf <- lmer(PAI ~ Treatment * Site quality + (1|siteplot) + (1|site),
               data = DAT.PAI)

summary(modelf)

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: PAI ~ Treatment * Site quality + (1 | siteplot) + (1 | site)
```

```
##    Data: DAT.PAI
##
## REML criterion at convergence: -70
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.51841 -0.55997  0.03256  0.57244  3.16180
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  siteplot (Intercept) 0.01418  0.1191
##  site     (Intercept) 0.01819  0.1349
##  Residual             0.03266  0.1807
## Number of obs: 330, groups:  siteplot, 66; site, 22
##
## Fixed effects:
##                                    Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)                         1.33564    0.05946 41.74981  22.461  < 2e-16
## TreatmentModerate                  -0.20636    0.06136 39.99822  -3.363  0.00171
## TreatmentHeavy                     -0.45764    0.06136 39.99822  -7.458 4.35e-09
## Site qualitySQ2                    -0.46836    0.08410 41.74981  -5.569 1.68e-06
## TreatmentModerate:Site qualitySQ2   0.08145    0.08678 39.99822   0.939  0.35355
## TreatmentHeavy:Site qualitySQ2      0.23564    0.08678 39.99822   2.715  0.00973
##
## (Intercept)                        ***
## TreatmentModerate                  **
## TreatmentHeavy                     ***
## Site qualitySQ2                    ***
## TreatmentModerate:Site qualitySQ2
## TreatmentHeavy:Site qualitySQ2     **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

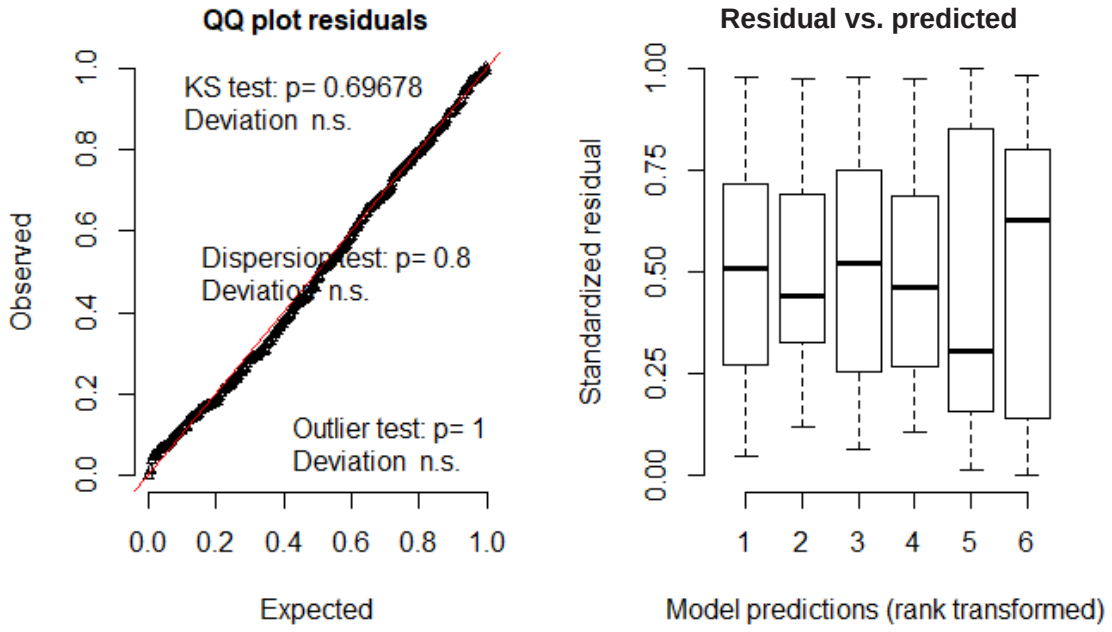


Figure 20 Dunn Smyth simulated residuals: plant area index

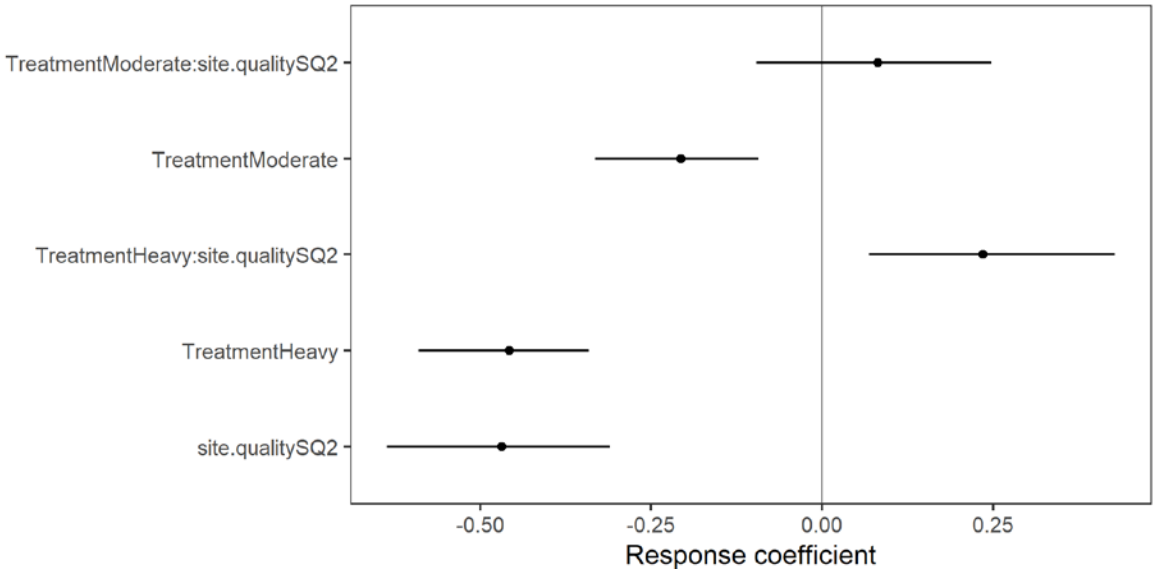


Figure 21 Bootstrapped confidence intervals for fixed effects: plant area index

Table 21 Bootstrapped model fitted values for average conditions: plant area index

Survey year	Site quality	Control	Moderate	Heavy
2019	SQ1	1.3280	1.1345	0.8794
2019	SQ2	0.8698	0.7266	0.6544

Appendix E: Model summaries – Fuel hazard

E.1 Overall fuel hazard

Table 22 Model fitting summary: overall fuel hazard

Response	Probability of being in each overall fuel hazard category
Response transformation used	None
Response transformations compared	None
R package and function	brms 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, adjacent categories 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 very high or extreme ratings.
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
Confidence comments	Low. A warning was issued that the Tail Effective Samples Size (ESS) was too low, indicating posterior variances and tail quantiles may be unreliable

Model results summary 12: overall fuel hazard

```
##  Family: cratio
##   Links: mu = logit; disc = identity
## Formula: risk.total.or ~ Survey year * Treatment + Site quality + (1 | fsiteplo
t) + (1 | fsite)
##    Data: DAT.fire (Number of observations: 789)
## Samples: 4 chains, each with iter = 2000; warmup = 1000; thin = 1;
##          total post-warmup samples = 4000
##
## Group-Level Effects:
## ~fsite (Number of levels: 22)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.39      0.18     0.04     0.75 1.00      553      787
##
## ~fsiteplot (Number of levels: 66)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.50      0.16     0.13     0.80 1.00      532      302
##
## Population-Level Effects:
##                                  Estimate Est.Error l-95% CI u-95% CI Rhat
## Intercept[1]                        -2.65      0.34    -3.36    -1.98 1.00
## Intercept[2]                         0.13      0.31    -0.49     0.75 1.00
## Intercept[3]                         7.03      0.85     5.56     8.93 1.00
## Survey year2017                      0.37      0.34    -0.27     1.05 1.00
## Survey year2018                      1.35      0.37     0.61     2.08 1.00
## Survey year2019                      1.42      0.38     0.68     2.19 1.00
## TreatmentModerate                   -0.02      0.37    -0.74     0.68 1.00
## TreatmentHeavy                       0.14      0.37    -0.59     0.87 1.00
## Site qualitySQ2                      0.06      0.27    -0.48     0.59 1.00
## Survey year2017:TreatmentModerate   -0.30      0.47    -1.23     0.63 1.00
## Survey year2018:TreatmentModerate   -0.33      0.51    -1.30     0.67 1.00
## Survey year2019:TreatmentModerate   -0.09      0.52    -1.11     0.91 1.00
## Survey year2017:TreatmentHeavy      -0.23      0.49    -1.19     0.69 1.00
## Survey year2018:TreatmentHeavy      -0.08      0.53    -1.07     0.96 1.00
## Survey year2019:TreatmentHeavy      -0.39      0.52    -1.43     0.62 1.00
##                                  Bulk_ESS Tail_ESS
## Intercept[1]                         2065     2590
## Intercept[2]                         1772     2172
## Intercept[3]                         3630     2445
## Survey year2017                      1789     2332
## Survey year2018                      1887     2815
## Survey year2019                      1687     2090
## TreatmentModerate                    1615     1965
## TreatmentHeavy                       1583     2219
## Site qualitySQ2                      2828     2882
## Survey year2017:TreatmentModerate    1987     2352
## Survey year2018:TreatmentModerate    2048     2812
## Survey year2019:TreatmentModerate    1920     2647
## Survey year2017:TreatmentHeavy       1899     2552
## Survey year2018:TreatmentHeavy       1967     2927
## Survey year2019:TreatmentHeavy       1864     2647
##
## Samples were drawn using sampling(NUTS). For each parameter, Bulk_ESS
## and Tail_ESS are effective sample size measures, and Rhat is the potential
## scale reduction factor on split chains (at convergence, Rhat = 1).
```

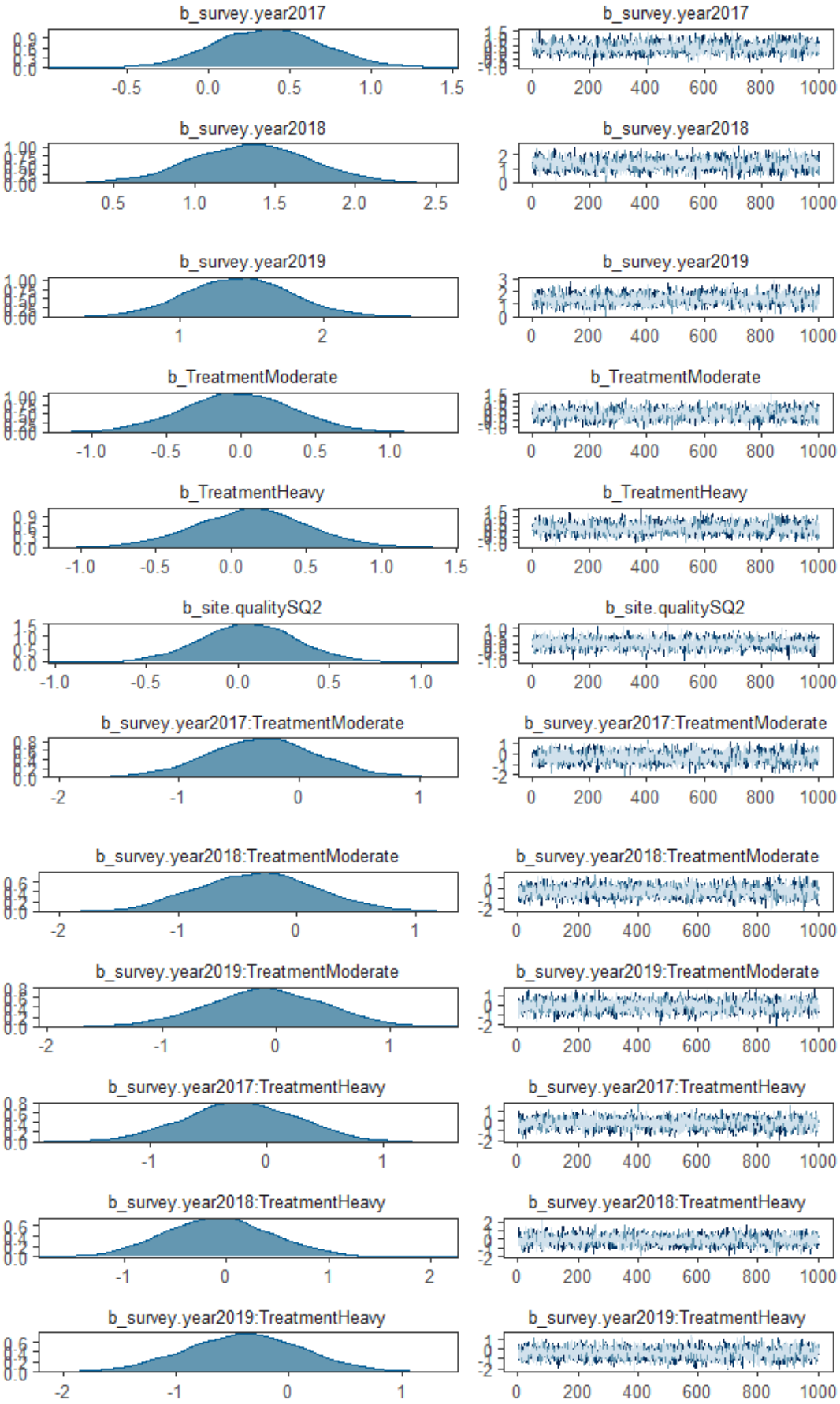


Figure 22 Posterior distributions (left) and chain mixing (right): overall fuel hazard

E.2 Surface fuel hazard

E.2.1 Litter depth

Table 23 Model fitting summary: litter depth

Response	Litter depth, measured at 30 locations in each 9 hectare plot, in millimetres A continuous positive variable Log transformed
Response transformation used	None
Other transformations compared	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two two-way interactions between thinning treatment and survey year, and thinning treatment and site quality A three-way model between thinning treatment, survey year and site quality was trialled but was not as parsimonious
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Marginal = 3.5% Conditional = 18.7%
Confidence comments	Moderate. Failed the Dunn Smyth uniformity test, with minor deviations

Model results summary 13: litter depth

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: log(litter.depth) ~ Survey year * Treatment + Site quality *
##     Treatment + (1 | siteplot) + (1 | fsite)
##    Data: DAT.litter

## REML criterion at convergence: 1166
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.2699 -0.5441  0.0628  0.6261  2.7392
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  siteplot (Intercept) 0.02405  0.1551
##  fsite    (Intercept) 0.01787  0.1337
##  Residual             0.22452  0.4738
## Number of obs: 787, groups:  siteplot, 66; fsite, 22
##
## Fixed effects:
##                                  Estimate Std. Error        df t value
## (Intercept)                       2.78216    0.08985 107.97966  30.963
## Survey year2017                   0.26937    0.08316 713.00082   3.239
## Survey year2018                   0.03320    0.08282 712.72343   0.401
## Survey year2019                   0.05132    0.08248 712.39259   0.622
## TreatmentModerate                -0.09638    0.11353 107.18907  -0.849
## TreatmentHeavy                    0.12870    0.11325 106.14693   1.136
## Site qualitySQ2                  -0.11687    0.10519  51.50363  -1.111
## Survey year2017:TreatmentModerate  -0.10186    0.11713 712.69952  -0.870
## Survey year2018:TreatmentModerate   0.04128    0.11689 712.55878   0.353
## Survey year2019:TreatmentModerate   0.03144    0.11665 712.39259   0.270
## Survey year2017:TreatmentHeavy     -0.15802    0.11765 713.27191  -1.343
## Survey year2018:TreatmentHeavy     -0.02982    0.11645 712.56002  -0.256
## Survey year2019:TreatmentHeavy     -0.09142    0.11668 712.63909  -0.784
## TreatmentModerate:Site qualitySQ2   0.22032    0.12487  40.18186   1.764
## TreatmentHeavy:Site qualitySQ2      0.04607    0.12501  40.34749   0.369
##                                  Pr(>|t|)
## (Intercept)                       < 2e-16 ***
## Survey year2017                   0.00125 **
## Survey year2018                   0.68866
## Survey year2019                   0.53401
## TreatmentModerate                 0.39778
## TreatmentHeavy                    0.25834
## Site qualitySQ2                   0.27172
## Survey year2017:TreatmentModerate  0.38477
## Survey year2018:TreatmentModerate  0.72407
## Survey year2019:TreatmentModerate  0.78759
## Survey year2017:TreatmentHeavy     0.17966
## Survey year2018:TreatmentHeavy     0.79797
## Survey year2019:TreatmentHeavy     0.43358
## TreatmentModerate:Site qualitySQ2  0.08526 .
## TreatmentHeavy:Site qualitySQ2     0.71440
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation matrix not shown by default, as p = 15 > 12.
## Use print(x, correlation=TRUE)  or
##     vcov(x)        if you need it
```

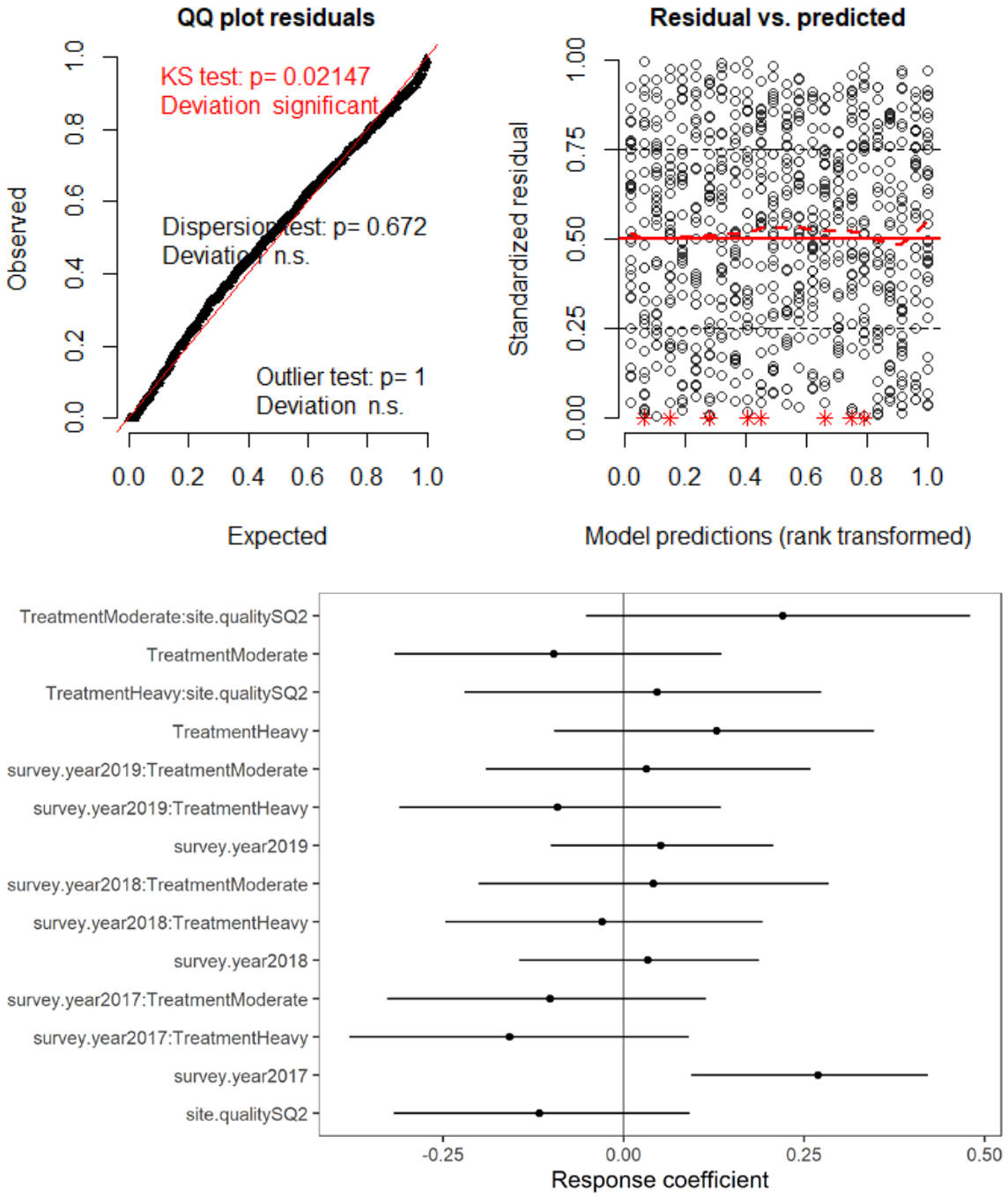


Figure 23 Bootstrapped confidence intervals for fixed effects: litter depth

Table 24 Bootstrapped model fitted values for average conditions: litter depth

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	16.0733	14.6850	18.4503
2017	SQ1	13.9698	16.4513	17.1007
2018	SQ1	21.8291	17.4387	20.6454
2019	SQ1	18.6883	19.0553	18.2791
2015	SQ2	16.7746	15.4586	18.4860
2017	SQ2	14.7309	17.9886	17.3682
2018	SQ2	16.5660	16.4356	17.5555
2019	SQ2	14.6351	17.0655	16.0848

E.2.2 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 Proportion variable
Response transformation	None
Response transformations compared	Log + 1 Square root Z transformed Logit 100 – x (where x is rounded to nearest whole value)
R package and function	glmmTMB from package glmmTMB
Distribution used	Beta
Other distributions compared	Binomial Negative binomial (using 100 – x transformation) Gaussian
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Interaction between thinning treatment and survey year Also trialled a model with three-way interaction between thinning treatment, survey year and site quality, which was less parsimonious
Random factors	site (a factor over sites), and siteplot (a factor over 9 ha treatment plots)
R^2	Function not available to calculate R^2 for beta family
Confidence comments	Low. Failed Dunn Smyth dispersion and uniformity tests

Model results summary 14: litter cover

```
modelf.cover.beta <- glmmTMB(litter.prop ~ Survey year*Treatment + Site quality +
(1|siteplot) + (1|site),
                      data = DAT.cover, family = beta_family())


summary(modelf.cover.beta)

##  Family: beta  ( logit )
## Formula:
## litter.prop ~ Survey year * Treatment + Site quality + (1 | siteplot) +
##     (1 | site)
## Data: DAT.cover
##
##      AIC      BIC   logLik deviance df.resid
##  -1301.2  -1226.5    666.6  -1333.2      771
```

```
##
## Random effects:
##
## Conditional model:
##  Groups   Name        Variance Std.Dev.
##  siteplot (Intercept) 0.01426  0.1194
##  site     (Intercept) 0.06226  0.2495
## Number of obs: 787, groups:  siteplot, 66; site, 22
##
## Overdispersion parameter for beta family (): 6.75
##
## Conditional model:
##                                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)                          1.321136   0.132926   9.939  < 2e-16 ***
## Survey year2017                     -0.193306   0.142713  -1.355  0.17557
## Survey year2018                      0.446458   0.150243   2.972  0.00296 **
## Survey year2019                      0.600563   0.151181   3.972 7.11e-05 ***
## TreatmentModerate                   -0.005564   0.146063  -0.038  0.96961
## TreatmentHeavy                       0.161643   0.148141   1.091  0.27521
## Site qualitySQ2                      0.188078   0.126011   1.493  0.13555
## Survey year2017:TreatmentModerate -0.086018   0.199101  -0.432  0.66572
## Survey year2018:TreatmentModerate  0.118504   0.211171   0.561  0.57468
## Survey year2019:TreatmentModerate -0.158092   0.210896  -0.750  0.45348
## Survey year2017:TreatmentHeavy    -0.295409   0.201194  -1.468  0.14203
## Survey year2018:TreatmentHeavy    -0.148226   0.211401  -0.701  0.48320
## Survey year2019:TreatmentHeavy    -0.188723   0.213477  -0.884  0.37667
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

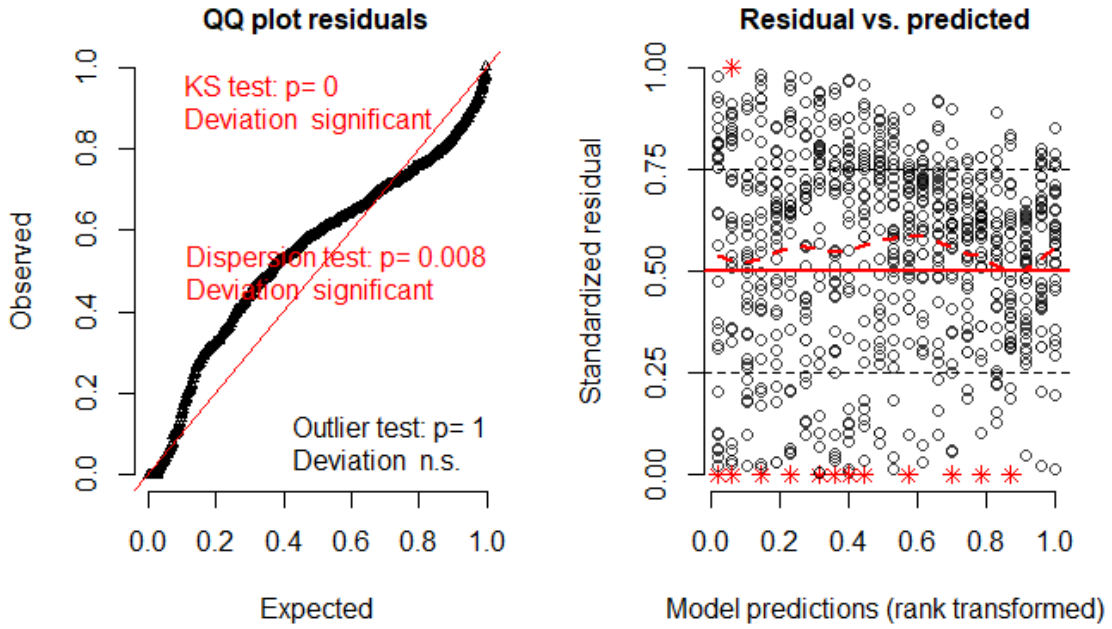


Figure 24 Dunn Smyth simulated residuals: litter cover

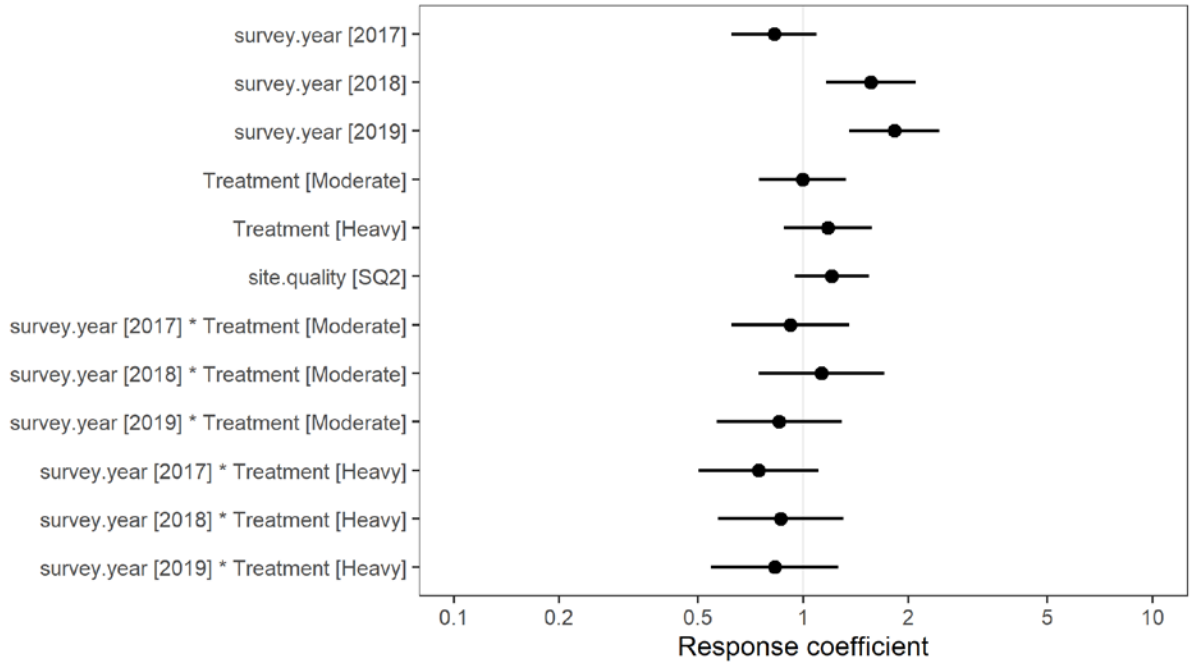


Figure 25 Wald confidence intervals for fixed effects: litter cover

Table 26 Model fitted values for average conditions: litter cover

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	83.4308	83.3537	85.5464
2017	SQ1	85.8702	85.8025	87.7201
2018	SQ1	80.5834	79.1102	78.4045
2019	SQ1	83.3584	82.0488	81.4191
2015	SQ2	88.7247	89.8061	88.8583
2017	SQ2	90.4737	91.4036	90.5887
2018	SQ2	90.1769	88.6288	89.9344
2019	SQ2	91.7216	90.3911	91.5137

E.2.3 Surface fuel assessment

Table 27 Model fitting summary: surface fuel hazard

Response	Probability of being in each surface fuel hazard category
Response transformation used	None
Other transformations compared	None
R package and function	brm from the brms package
Distribution used	Continuation ratio with flexible category thresholds – see explanation for overall fuel hazard above
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Not applicable
Confidence comments	Moderate

Model results summary 15: surface fuel hazard

```
##  Family: cratio
##   Links: mu = logit; disc = identity
## Formula: risk.surface.or ~ Survey year * Treatment + Site quality + (1 | fsitep
lot) + (1 | fsite)
##    Data: DAT.fire (Number of observations: 789)
## Samples: 4 chains, each with iter = 2000; warmup = 1000; thin = 1;
##          total post-warmup samples = 4000
##
## Group-Level Effects:
## ~fsite (Number of levels: 22)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.35      0.16     0.03     0.69 1.00      599     1076
##
## ~fsiteplot (Number of levels: 66)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.53      0.11     0.31     0.75 1.00      956     1601
##
## Population-Level Effects:
##                                   Estimate Est.Error l-95% CI u-95% CI Rhat
## Intercept[1]                         -2.67      0.30    -3.29    -2.07 1.00
## Intercept[2]                         -0.57      0.28    -1.10    -0.02 1.00
## Intercept[3]                          1.17      0.29     0.61     1.74 1.00
## Intercept[4]                          3.60      0.44     2.77     4.51 1.00
## Survey year2017                       0.07      0.29    -0.50     0.63 1.00
## Survey year2018                       0.66      0.29     0.11     1.23 1.00
## Survey year2019                       0.51      0.29    -0.05     1.07 1.00
## TreatmentModerate                    -0.14      0.33    -0.77     0.52 1.00
## TreatmentHeavy                        0.17      0.33    -0.46     0.84 1.00
## Site qualitySQ2                      -0.06      0.24    -0.54     0.40 1.00
## Survey year2017:TreatmentModerate    -0.11      0.41    -0.90     0.68 1.00
## Survey year2018:TreatmentModerate    -0.09      0.40    -0.90     0.66 1.00
## Survey year2019:TreatmentModerate     0.22      0.41    -0.57     1.03 1.00
## Survey year2017:TreatmentHeavy       -0.47      0.41    -1.28     0.33 1.00
## Survey year2018:TreatmentHeavy       -0.20      0.41    -1.03     0.59 1.00
## Survey year2019:TreatmentHeavy       -0.18      0.40    -0.96     0.58 1.00
##                                   Bulk_ESS Tail_ESS
## Intercept[1]                          2191     3068
## Intercept[2]                          1980     2589
## Intercept[3]                          2123     2858
## Intercept[4]                          3287     3026
## Survey year2017                       2290     2807
## Survey year2018                       1889     2838
## Survey year2019                       2212     3185
## TreatmentModerate                     1963     2543
## TreatmentHeavy                        2122     2443
## Site qualitySQ2                       3094     2810
## Survey year2017:TreatmentModerate     2491     2868
## Survey year2018:TreatmentModerate     2202     2878
## Survey year2019:TreatmentModerate     2410     2552
## Survey year2017:TreatmentHeavy        2848     3132
## Survey year2018:TreatmentHeavy        2267     2737
## Survey year2019:TreatmentHeavy        2322     2948
##
## Samples were drawn using sampling(NUTS). For each parameter, Bulk_ESS
## and Tail_ESS are effective sample size measures, and Rhat is the potential
## scale reduction factor on split chains (at convergence, Rhat = 1).
```

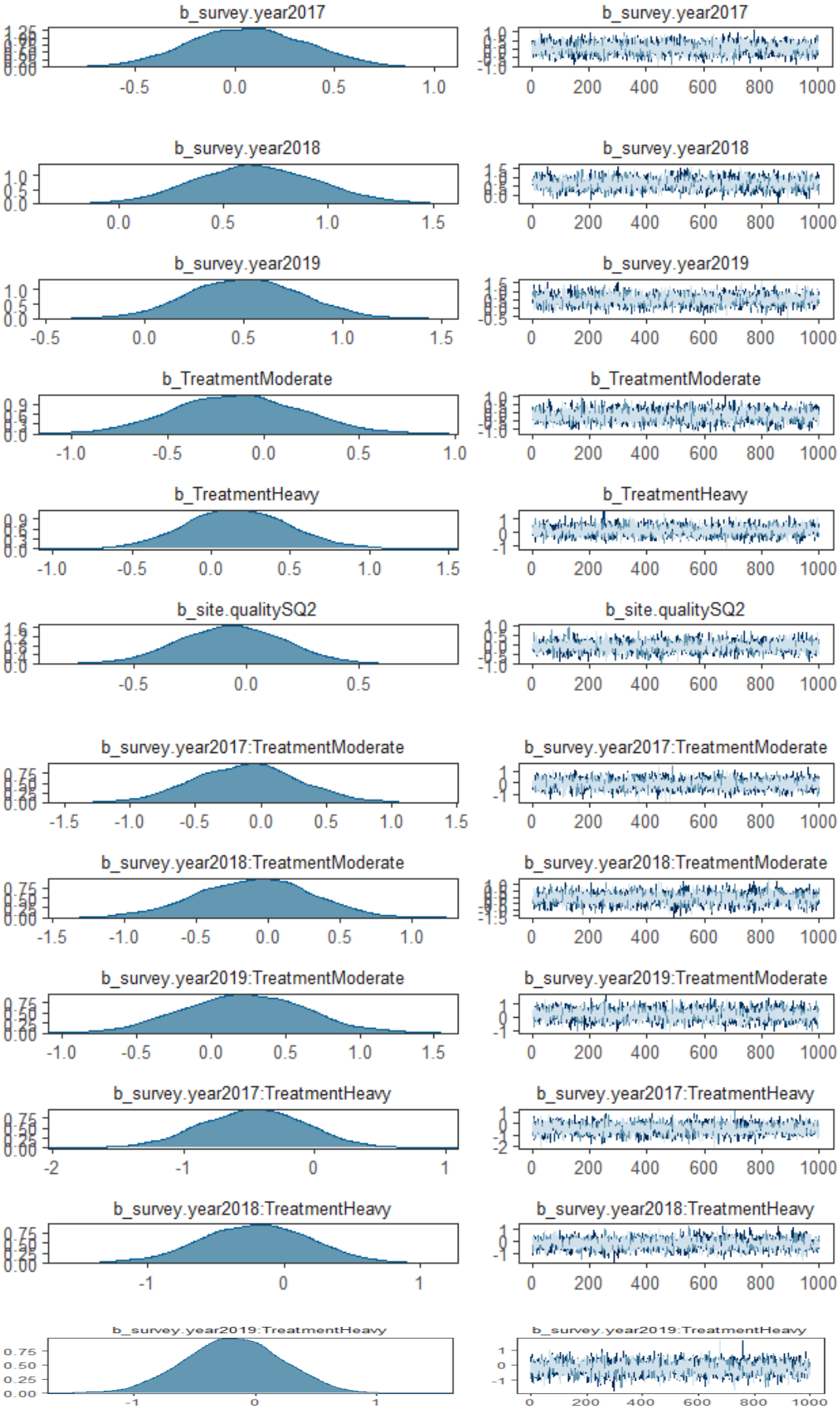


Figure 26 Posterior distributions (left) and chain mixing (right): surface fuel hazard

E.3 Near surface fuel hazard

E.3.1 Live near surface vegetation cover

Table 28 Model fitting summary: live near surface vegetation cover

Response	Percent live vegetation cover visually estimated for three 0.04 ha subplots in each 9 ha plot Percentage: positive continuous bounded variable
Response transformation used	$Log_e(x)$
Other transformations compared	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	Beta – failed Dunn Smyth tests
Outliers removed	One zero value recorded in 2015, likely an observer error.
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Marginal = 25.1% Conditional = 42.9%
Confidence comments	Moderate – High. Passed all Dunn Smyth tests

Model results summary 16: live near surface vegetation cover

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: log(nearsurface.live) ~ Survey year * Treatment + Site quality +
##     (1 | fsite) + (1 | fsiteplot)
##    Data: DAT.vegcover1
##
## REML criterion at convergence: 2285
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.7132 -0.5624  0.0045  0.6157  3.2115
##
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  fsiteplot (Intercept) 0.06134  0.2477
```

```
##  fsite     (Intercept) 0.22814  0.4776
##  Residual              0.92740  0.9630
## Number of obs: 794, groups:  fsiteplot, 66; fsite, 22
##
## Fixed effects:
##                                    Estimate Std. Error        df t value
## (Intercept)                        -2.48937    0.19919  49.69669 -12.497
## Survey year2017                     0.44989    0.16764 718.91630   2.684
## Survey year2018                    -0.74758    0.16764 718.91630  -4.459
## Survey year2019                    -1.01290    0.16764 718.91630  -6.042
## TreatmentModerate                   0.16774    0.18352 257.93252   0.914
## TreatmentHeavy                      0.01144    0.18358 257.78835   0.062
## Site qualitySQ2                    -0.40441    0.22332  19.99104  -1.811
## Survey year2017:TreatmentModerate  -0.46520    0.23708 718.91630  -1.962
## Survey year2018:TreatmentModerate  -0.25429    0.23708 718.91630  -1.073
## Survey year2019:TreatmentModerate  -0.26344    0.23708 718.91630  -1.111
## Survey year2017:TreatmentHeavy     -0.14500    0.23666 719.10916  -0.613
## Survey year2018:TreatmentHeavy     -0.16659    0.23666 719.10916  -0.704
## Survey year2019:TreatmentHeavy     -0.26556    0.23712 719.25503  -1.120
##                                   Pr(>|t|)
## (Intercept)                        < 2e-16 ***
## Survey year2017                    0.00745 **
## Survey year2018                   9.53e-06 ***
## Survey year2019                   2.44e-09 ***
## TreatmentModerate                  0.36157
## TreatmentHeavy                     0.95038
## Site qualitySQ2                    0.08522 .
## Survey year2017:TreatmentModerate  0.05012 .
## Survey year2018:TreatmentModerate  0.28382
## Survey year2019:TreatmentModerate  0.26685
## Survey year2017:TreatmentHeavy     0.54028
## Survey year2018:TreatmentHeavy     0.48172
## Survey year2019:TreatmentHeavy     0.26312
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

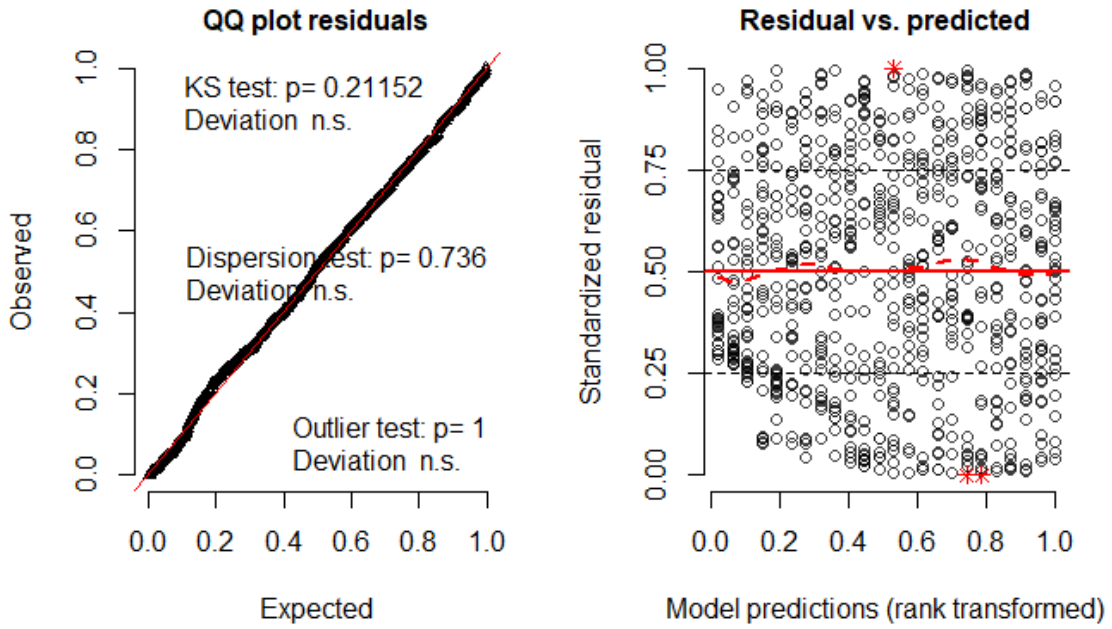


Figure 27 Dunn Smyth simulated residuals: live near surface vegetation cover

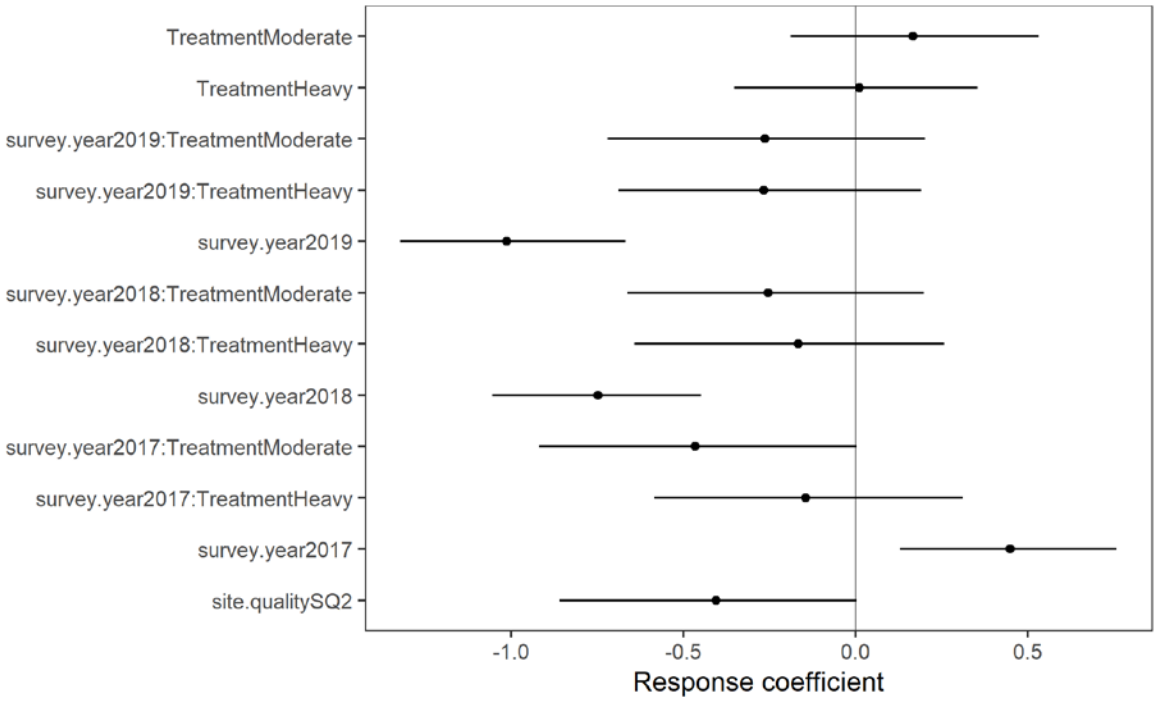


Figure 28 Bootstrapped confidence intervals for fixed effects: live near surface vegetation cover

Table 29 Bootstrapped model fitted values for average conditions: live near surface vegetation cover

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	8.6345	9.8558	8.4999
2017	SQ1	12.7172	9.7288	11.1641
2018	SQ1	3.9332	3.7513	3.3207
2019	SQ1	2.9972	2.6691	2.3984
2015	SQ2	5.5926	6.4783	5.9869
2017	SQ2	8.3257	6.8355	7.5032
2018	SQ2	2.7353	2.2973	2.1884
2019	SQ2	1.9620	1.8106	1.5690

E.3.2 Dead near surface vegetation cover

Table 30 Model fitting summary: dead near surface vegetation cover

Response	Percent dead near surface visually estimated for three 0.04 ha subplots in each 9 ha plot Percentage: positive continuous bounded variable
Response transformation used	$Log_e(x + 0.001)$
Other transformations compared	X + 0.001 (a small constant to enable zero values to be modelled)
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	Beta
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year. Also trialled a model with a three-way interaction between thinning treatment, survey year and site quality, which had a higher AIC (that is, worse fit). The three-way model detected an additional significant effect of higher dead near surface cover on heavily thinned plots in SQ2 in 2018. However, the bootstrapped confidence interval included zero and therefore the two-way model was reported
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Function not available to calculate R^2 for beta distribution
Confidence comments	Moderate. Failed the Dunn Smyth uniformity test

Model results summary 17: dead near surface vegetation cover

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## log(nearsurface.dead + 1e-04) ~ Survey year * Treatment + Site quality +
##     (1 | fsite) + (1 | fsiteplot)
##    Data: DAT.vegcover
##
## REML criterion at convergence: 2393.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.9234 -0.4903  0.0060  0.5382  3.1292
##
## Random effects:
```

```
##  Groups    Name        Variance Std.Dev.
##  fsiteplot (Intercept) 0.03827  0.1956
##  fsite     (Intercept) 0.18653  0.4319
##  Residual              1.08345  1.0409
## Number of obs: 795, groups:  fsiteplot, 66; fsite, 22
##
## Fixed effects:
##                                    Estimate Std. Error        df t value
## (Intercept)                        -4.50353    0.19250  61.52529 -23.395
## Survey year2017                     1.18131    0.18120 719.83834   6.520
## Survey year2018                     0.89815    0.18120 719.83834   4.957
## Survey year2019                     0.84626    0.18120 719.83834   4.670
## TreatmentModerate                  -0.08854    0.19055 322.41217  -0.465
## TreatmentHeavy                      0.26339    0.18993 319.20925   1.387
## Site qualitySQ2                    -0.18097    0.20418  19.97766  -0.886
## Survey year2017:TreatmentModerate   0.06834    0.25625 719.83834   0.267
## Survey year2018:TreatmentModerate   0.07235    0.25625 719.83834   0.282
## Survey year2019:TreatmentModerate   0.09909    0.25625 719.83834   0.387
## Survey year2017:TreatmentHeavy     -0.02459    0.25529 719.83834  -0.096
## Survey year2018:TreatmentHeavy     -0.42554    0.25529 719.83834  -1.667
## Survey year2019:TreatmentHeavy     -0.28747    0.25579 720.01159  -1.124
##                                   Pr(>|t|)
## (Intercept)                        < 2e-16 ***
## Survey year2017                   1.33e-10 ***
## Survey year2018                   8.94e-07 ***
## Survey year2019                   3.59e-06 ***
## TreatmentModerate                    0.642
## TreatmentHeavy                       0.166
## Site qualitySQ2                      0.386
## Survey year2017:TreatmentModerate    0.790
## Survey year2018:TreatmentModerate    0.778
## Survey year2019:TreatmentModerate    0.699
## Survey year2017:TreatmentHeavy       0.923
## Survey year2018:TreatmentHeavy       0.096 .
## Survey year2019:TreatmentHeavy       0.261
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

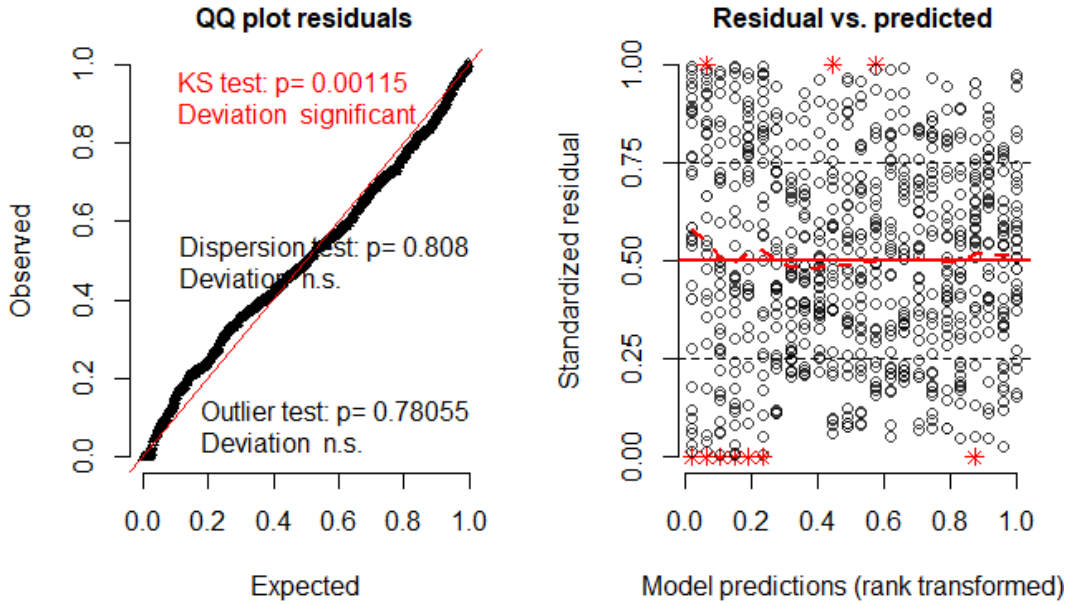


Figure 29 Dunn Smyth simulated residuals: dead near surface vegetation cover

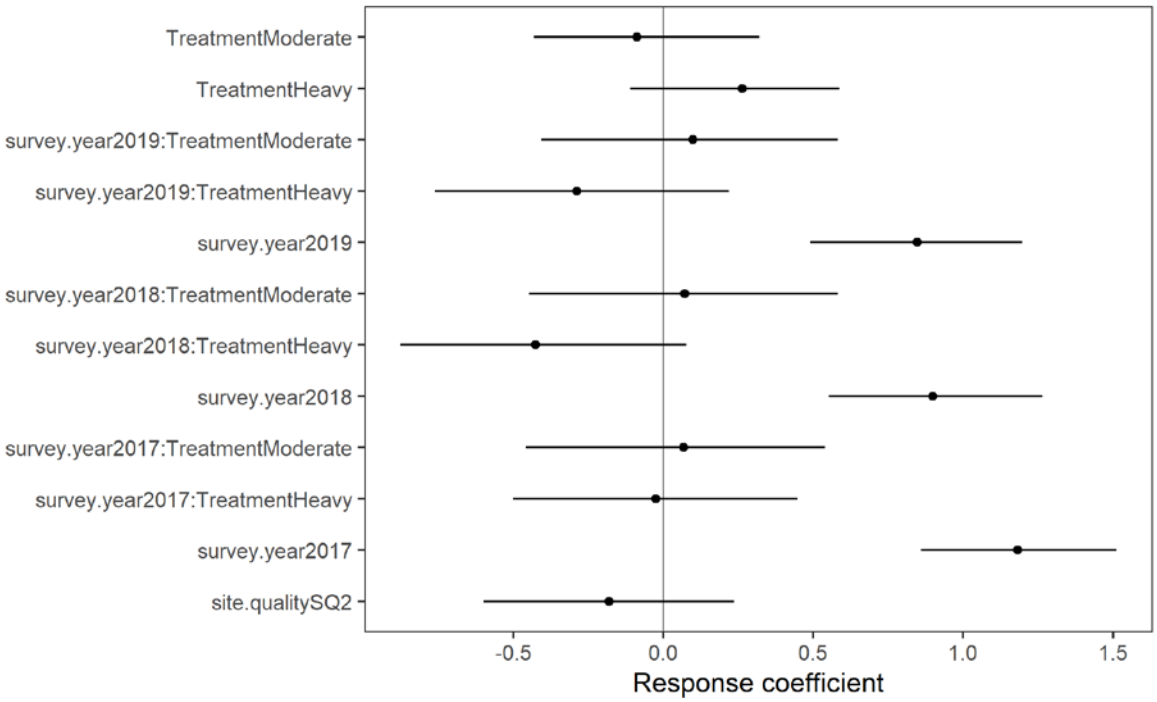


Figure 30 Bootstrapped confidence intervals for fixed effects: dead near surface vegetation cover

Table 31 Bootstrapped model fitted values for average conditions: dead near surface vegetation cover

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	1.1014	0.9853	1.3681
2017	SQ1	3.6757	3.7828	4.3027
2018	SQ1	2.6153	2.9059	2.4583
2019	SQ1	2.7029	2.5790	2.3671
2015	SQ2	0.9144	0.8630	1.2340
2017	SQ2	3.0263	2.7434	3.7986
2018	SQ2	2.2868	2.0926	1.8039
2019	SQ2	2.2119	2.1365	2.1045

E.3.3 Near surface fuel assessment

Table 32 Model fitting summary: near surface fuel hazard

Response	Probability of being in each near surface fuel hazard category
Response transformation used	None
Other transformations compared	None
R package and function	brm from the brms package
Distribution used	Continuation ratio with flexible category thresholds – see explanation for overall fuel hazard above
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	fsite (a factor over sites) and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Not applicable
Confidence comments	Moderate

Model results summary 18: near surface fuel hazard

```
##  Family: cratio
##   Links: mu = logit; disc = identity
## Formula: risk.nearsurface.or ~ Survey year * Treatment + Site quality + (1 | fs
iteplot) + (1 | fsite)
##    Data: DAT.fire (Number of observations: 795)
## Samples: 4 chains, each with iter = 2000; warmup = 1000; thin = 1;
##          total post-warmup samples = 4000
##
## Group-Level Effects:
## ~fsite (Number of levels: 22)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.64      0.19     0.30     1.05 1.00     1005      859
##
## ~fsiteplot (Number of levels: 66)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.56      0.14     0.30     0.84 1.01     1018     1831
##
## Population-Level Effects:
##                                   Estimate Est.Error l-95% CI u-95% CI Rhat
## Intercept[1]                         -1.63      0.37    -2.36    -0.89 1.00
## Intercept[2]                          1.75      0.38     1.00     2.55 1.00
## Intercept[3]                          4.82      0.49     3.90     5.81 1.00
## Intercept[4]                          3.18      0.82     1.62     4.88 1.00
## Survey year2017                       1.56      0.35     0.87     2.25 1.00
## Survey year2018                       1.43      0.36     0.72     2.16 1.00
## Survey year2019                       1.33      0.35     0.63     2.01 1.00
## TreatmentModerate                     0.12      0.39    -0.64     0.89 1.00
## TreatmentHeavy                        0.64      0.40    -0.16     1.43 1.00
## Site qualitySQ2                      -0.46      0.36    -1.17     0.26 1.00
## Survey year2017:TreatmentModerate    -0.29      0.48    -1.24     0.63 1.00
## Survey year2018:TreatmentModerate     0.32      0.49    -0.67     1.25 1.00
## Survey year2019:TreatmentModerate    -0.47      0.49    -1.45     0.50 1.00
## Survey year2017:TreatmentHeavy       -0.40      0.48    -1.34     0.56 1.00
## Survey year2018:TreatmentHeavy       -0.62      0.50    -1.59     0.38 1.00
## Survey year2019:TreatmentHeavy       -0.99      0.49    -1.95    -0.04 1.00
##                                   Bulk_ESS Tail_ESS
## Intercept[1]                          1792     2282
## Intercept[2]                          1702     2575
## Intercept[3]                          2166     2581
## Intercept[4]                          4193     3330
## Survey year2017                       1919     2554
## Survey year2018                       2002     2828
## Survey year2019                       1870     2306
## TreatmentModerate                     1749     2235
## TreatmentHeavy                        1922     2174
## Site qualitySQ2                       2357     2158
## Survey year2017:TreatmentModerate     2106     3004
## Survey year2018:TreatmentModerate     2148     2716
## Survey year2019:TreatmentModerate     2060     2402
## Survey year2017:TreatmentHeavy        2212     2970
## Survey year2018:TreatmentHeavy        2164     2639
## Survey year2019:TreatmentHeavy        2052     2463
##
## Samples were drawn using sampling(NUTS). For each parameter, Bulk_ESS
## and Tail_ESS are effective sample size measures, and Rhat is the potential
## scale reduction factor on split chains (at convergence, Rhat = 1).
```

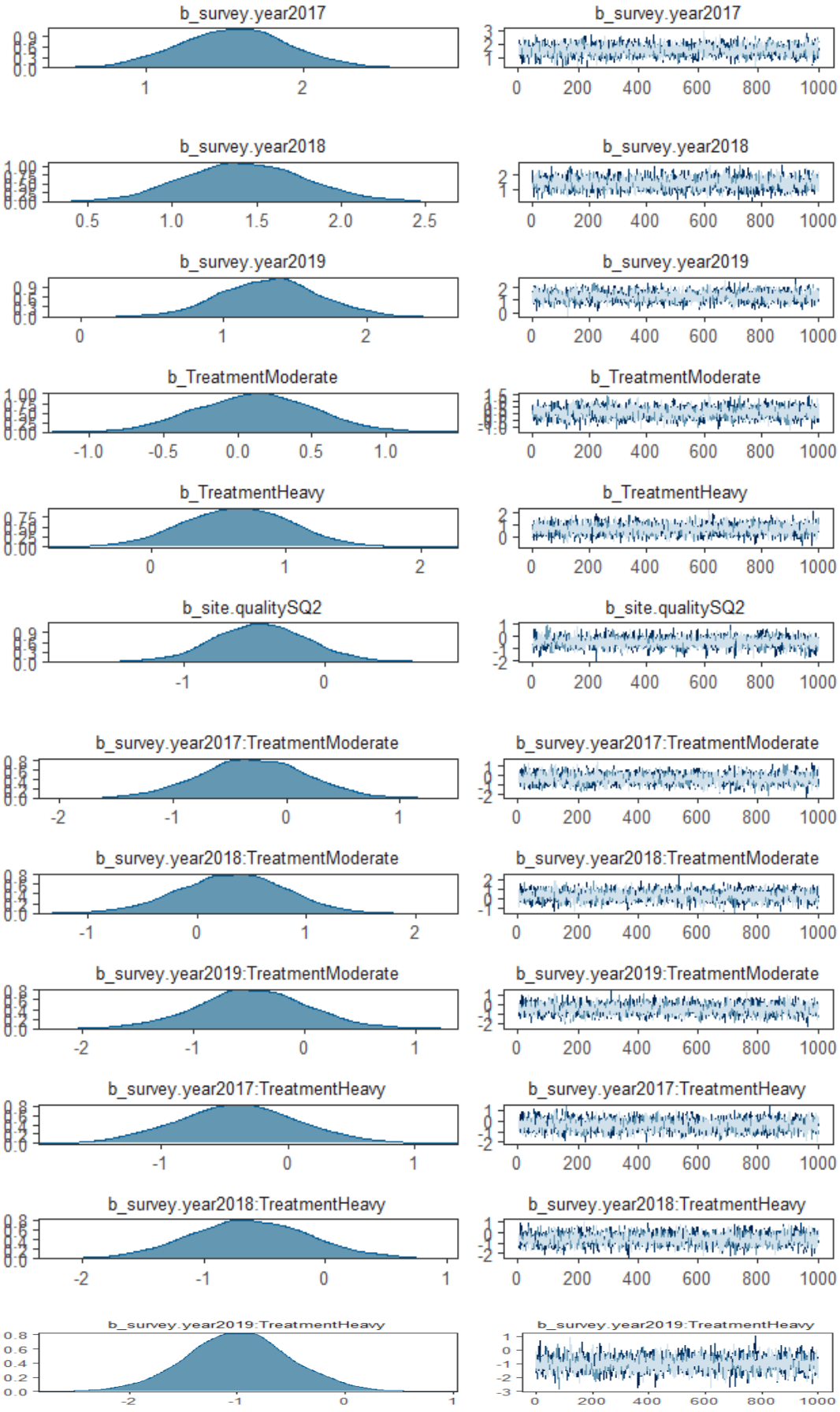


Figure 31 Posterior distributions (left) and chain mixing (right): near surface fuel hazard

E.4 Combined surface and near surface fuel hazard

Table 33 Model fitting summary: combined surface and near surface fuel hazard

Response	Probability of being in each combined surface and near surface fuel hazard category
Response transformation used	None
Other transformations compared	None
R package and function	brm from the brms package
Distribution used	Continuation ratio with flexible category thresholds – see explanation for overall fuel hazard above
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Not applicable
Confidence comments	Moderate

Model results summary 19: combined surface and near surface fuel hazard

```
##  Family: cratio
##   Links: mu = logit; disc = identity
## Formula: risk.surfacecomb.or ~ Survey year * Treatment + Site quality + (1 | fs
iteplot) + (1 | fsite)
##    Data: DAT.fire (Number of observations: 789)
## Samples: 4 chains, each with iter = 2000; warmup = 1000; thin = 1;
##          total post-warmup samples = 4000
##
## Group-Level Effects:
## ~fsite (Number of levels: 22)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.36      0.14     0.06     0.66 1.00      583      496
##
## ~fsiteplot (Number of levels: 66)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.42      0.13     0.15     0.65 1.00      689      788
##
## Population-Level Effects:

##                                  Estimate Est.Error l-95% CI u-95% CI Rhat
## Intercept[1]                        -2.81      0.30    -3.40    -2.23 1.00
## Intercept[2]                        -0.91      0.27    -1.43    -0.40 1.00
## Intercept[3]                        -1.03      0.27    -1.57    -0.51 1.00
## Intercept[4]                         2.78      0.30     2.19     3.38 1.00
## Survey year2017                      0.41      0.29    -0.14     0.99 1.00
## Survey year2018                      0.86      0.29     0.30     1.42 1.00
## Survey year2019                      0.84      0.29     0.27     1.43 1.00
## TreatmentModerate                   -0.15      0.30    -0.75     0.45 1.00
## TreatmentHeavy                       0.21      0.31    -0.39     0.82 1.00
## Site qualitySQ2                     -0.07      0.24    -0.53     0.39 1.00
## Survey year2017:TreatmentModerate   -0.27      0.40    -1.04     0.51 1.00
## Survey year2018:TreatmentModerate    0.21      0.41    -0.57     1.02 1.00
## Survey year2019:TreatmentModerate    0.11      0.41    -0.70     0.90 1.00
## Survey year2017:TreatmentHeavy      -0.39      0.41    -1.18     0.39 1.00
## Survey year2018:TreatmentHeavy      -0.16      0.40    -0.94     0.62 1.00
## Survey year2019:TreatmentHeavy      -0.30      0.41    -1.12     0.49 1.00
##                                  Bulk_ESS Tail_ESS
## Intercept[1]                         2099     2609
## Intercept[2]                         1770     2544
## Intercept[3]                         1745     2362
## Intercept[4]                         1855     2240
## Survey year2017                      1821     2710
## Survey year2018                      1703     2447
## Survey year2019                      1874     2478
## TreatmentModerate                    1567     2492
## TreatmentHeavy                       1456     1829
## Site qualitySQ2                      2362     2357
## Survey year2017:TreatmentModerate    1886     2727
## Survey year2018:TreatmentModerate    2126     2744
## Survey year2019:TreatmentModerate    1964     2145
## Survey year2017:TreatmentHeavy       1851     2847
## Survey year2018:TreatmentHeavy       1887     2603
## Survey year2019:TreatmentHeavy       1988     2870

## Samples were drawn using sampling(NUTS). For each parameter, Bulk_ESS
## and Tail_ESS are effective sample size measures, and Rhat is the potential
## scale reduction factor on split chains (at convergence, Rhat = 1).
```

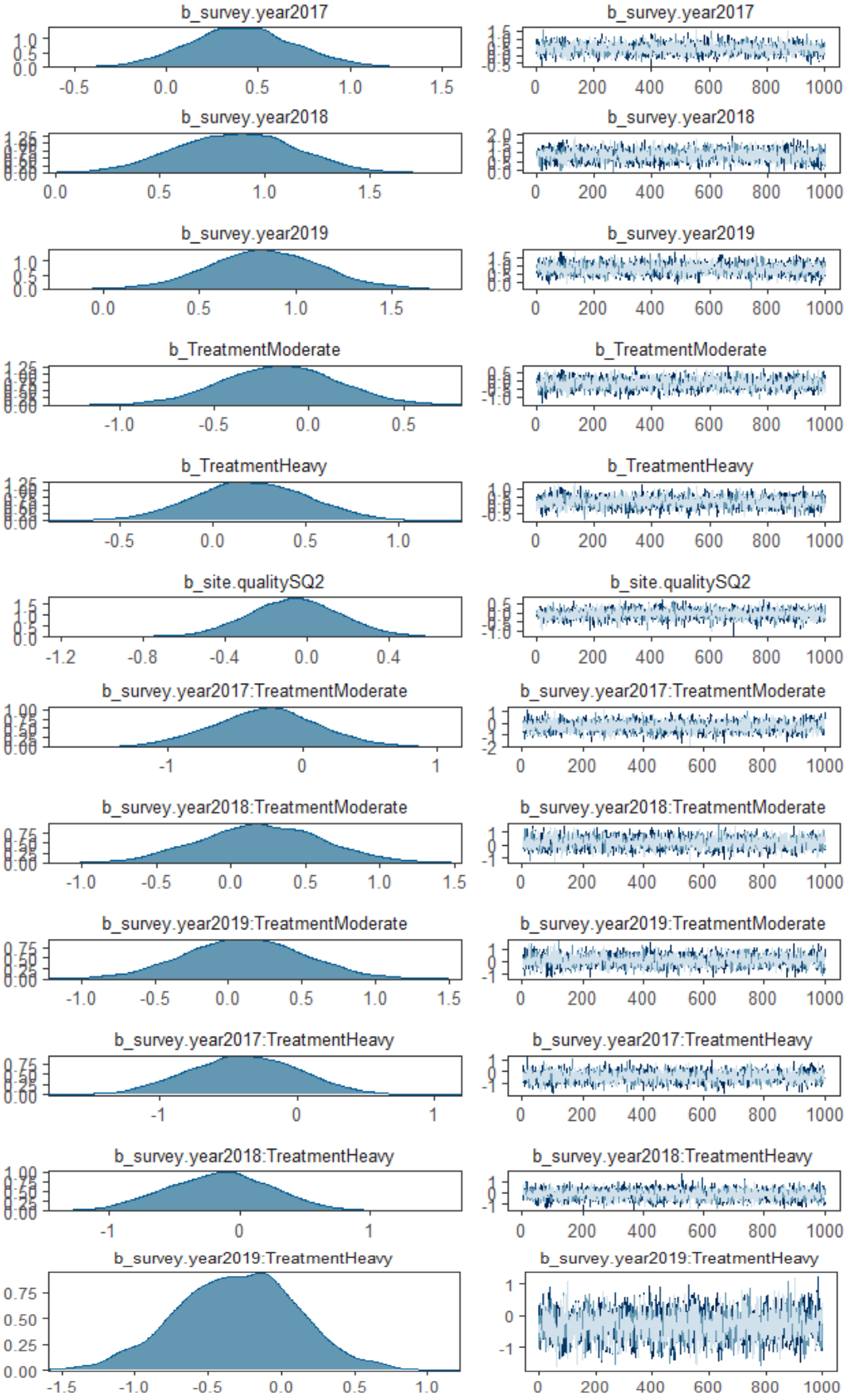


Figure 32 Posterior distributions (left) and chain mixing (right): combined surface and near surface fuel hazard

E.5 Elevated fuel hazard

E.5.1 Live elevated vegetation cover

Table 34 Model fitting summary: live elevated vegetation cover

Response	Percent live elevated cover visually estimated for three 0.04 ha subplots in each 9 ha plot Percentage: positive continuous bounded variable
Response transformation used	X + 0.001
Other transformations compared	$Log_e(x)$ (with gaussian distribution)
R package and function	glmmTMB function from the glmmTMB package
Distribution used	Beta
Other distributions compared	Gaussian (with $log_e(x)$ transformation)
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year Also trialled a model with three-way interaction between thinning treatment, survey year and site quality, which was less parsimonious
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	No function is available for calculating R^2 for beta models
Confidence comments	Moderate to high. Passed all Dunn Smyth tests

Model results summary 20: live elevated vegetation cover

```
summary(model_el_beta)

##  Family: beta  ( logit )
## Formula:
## (elevated.live + 1e-04) ~ Survey year * Treatment + Site quality +
##     (1 | fsite) + (1 | fsiteplot)
## Data: DAT.vegcover
##      AIC      BIC   logLik deviance df.resid
##  -4330.7  -4255.9   2181.4  -4362.7      779
##
## Random effects:
##
## Conditional model:
##  Groups    Name        Variance Std.Dev.
##  fsite     (Intercept) 0.05378  0.2319
##  fsiteplot (Intercept) 0.08282  0.2878
## Number of obs: 795, groups:  fsite, 22; fsiteplot, 66
## Overdispersion parameter for beta family (): 38.9
## Conditional model:
##                                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)                          -3.01745    0.13427 -22.473  < 2e-16 ***
## Survey year2017                      -0.10834    0.12478  -0.868 0.385228
## Survey year2018                       0.09478    0.11989   0.791 0.429195
## Survey year2019                       0.72874    0.11156   6.532 6.48e-11 ***
## TreatmentModerate                    -0.08192    0.15086  -0.543 0.587125
## TreatmentHeavy                       -0.29190    0.15447  -1.890 0.058805 .
## Site qualitySQ2                      -0.45073    0.13231  -3.407 0.000658 ***
## Survey year2017:TreatmentModerate    -0.97090    0.19052  -5.096 3.47e-07 ***
## Survey year2018:TreatmentModerate    -0.86713    0.18326  -4.732 2.23e-06 ***
## Survey year2019:TreatmentModerate     0.07530    0.15806   0.476 0.633786
## Survey year2017:TreatmentHeavy       -0.94008    0.19405  -4.844 1.27e-06 ***
## Survey year2018:TreatmentHeavy       -0.98179    0.19013  -5.164 2.42e-07 ***
## Survey year2019:TreatmentHeavy       -0.03564    0.16445  -0.217 0.828421
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

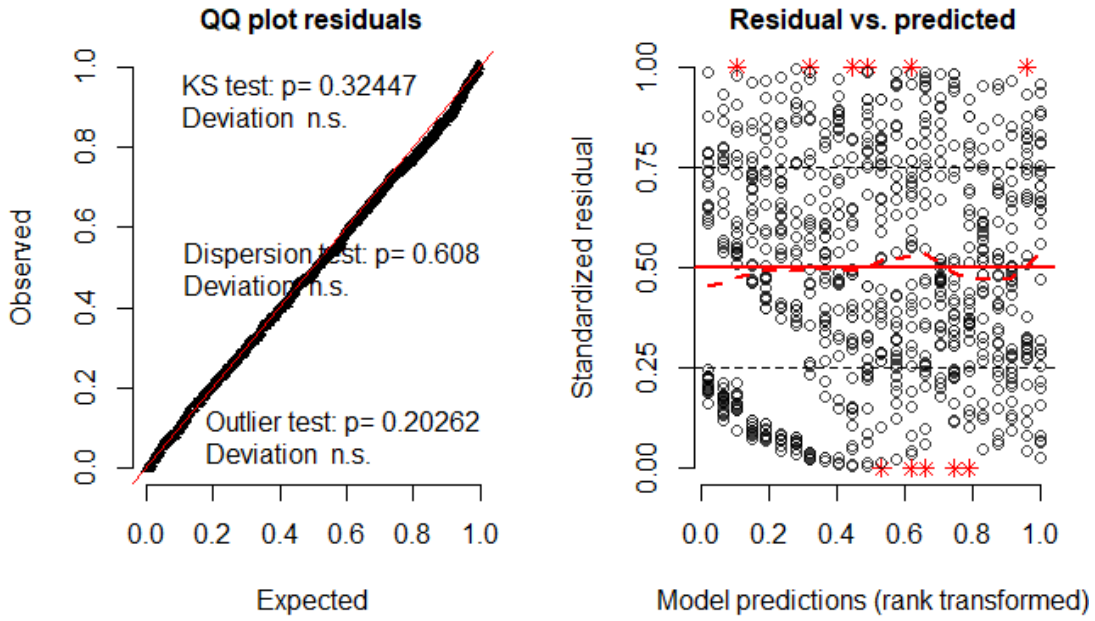


Figure 33 Dunn Smyth simulated residuals: live elevated vegetation

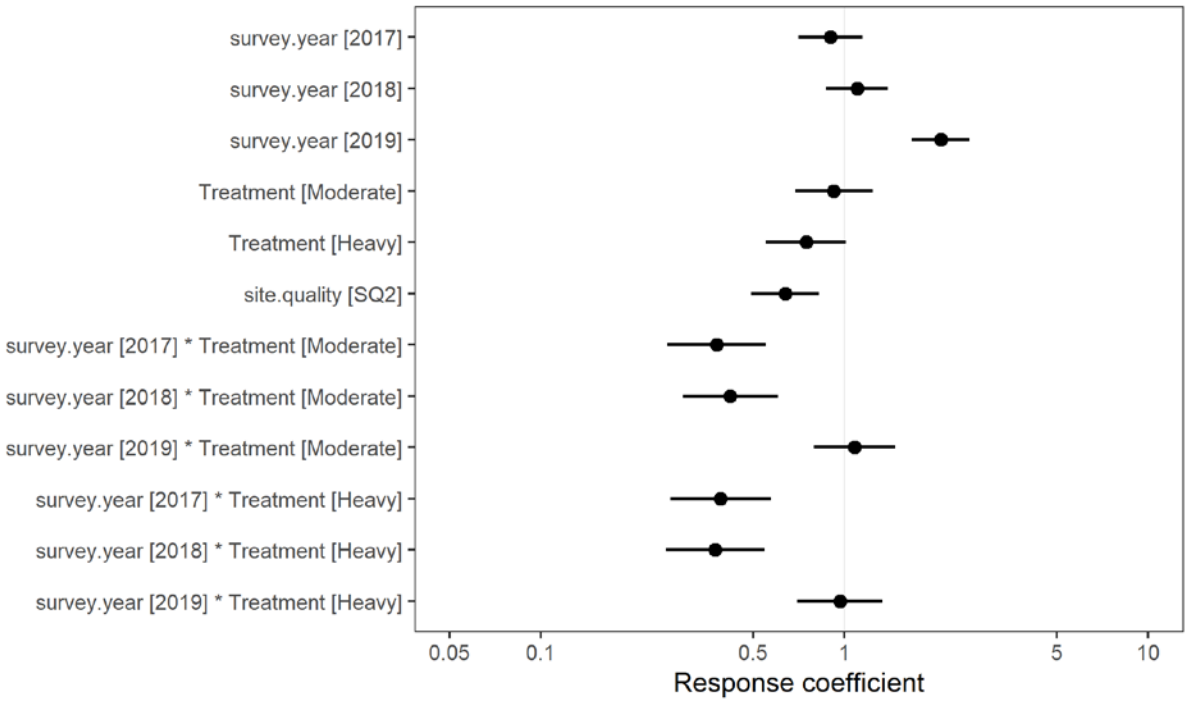


Figure 34 Wald confidence intervals for fixed effects: live elevated vegetation cover

Table 35 Model fitted values for average conditions: live elevated vegetation cover

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	4.6830	4.3299	3.5371
2017	SQ1	4.2215	1.5084	1.2625
2018	SQ1	5.1256	2.0427	1.4821
2019	SQ1	9.2501	9.1946	6.8409
2015	SQ2	3.0320	2.7995	2.2795
2017	SQ2	2.7282	0.9628	0.8046
2018	SQ2	3.3244	1.3077	0.9459
2019	SQ2	6.0953	6.0575	4.4664

E.5.2 Dead elevated vegetation cover

Table 36 Model fitting summary: dead elevated vegetation cover

Response	Percent dead elevated cover visually estimated for three 0.04 ha subplots in each 9 ha plot Percentage: positive continuous bounded variable
Response transformation used	X + 0.001
Other transformations compared	$Log_e(x)$ (with gaussian distribution)
R package and function	glmmTMB function from the glmmTMB package
Distribution used	Beta
Other distributions compared	Gaussian (with $log_e(x)$ transformation)
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year Also trialled a model with three-way interaction between thinning treatment, survey year and site quality, which was less parsimonious
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	No function is available for calculating R^2 for beta models
Confidence comments	Low to moderate. Failed Dunn Smyth uniformity and dispersion tests

Model results summary 21: dead elevated vegetation cover

```
##  Family: beta  ( logit )
## Formula:
## (elevated.dead + 1e-04) ~ Survey year * Treatment + Site quality +
##     (1 | fsite) + (1 | fsiteplot)
## Data: DAT.vegcover2
##
##      AIC      BIC   logLik deviance df.resid
##  -7078.2  -7003.4   3555.1  -7110.2      778
##
## Random effects:
##
## Conditional model:
##  Groups    Name        Variance Std.Dev.
##  fsite     (Intercept) 0.03908  0.1977
##  fsiteplot (Intercept) 0.03843  0.1960
## Number of obs: 794, groups:  fsite, 22; fsiteplot, 66
##
## Overdispersion parameter for beta family ():  278
```

```
##
## Conditional model:
##                                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)                          -5.78347    0.13199  -43.82  < 2e-16 ***
## Survey year2017                       0.71276    0.13025    5.47 4.44e-08 ***
## Survey year2018                       0.98834    0.12647    7.82 5.50e-15 ***
## Survey year2019                       1.47464    0.12013   12.28  < 2e-16 ***
## TreatmentModerate                    -0.21372    0.15801   -1.35 0.176189
## TreatmentHeavy                       -0.27235    0.15806   -1.72 0.084875 .
## Site qualitySQ2                      -0.08722    0.10859   -0.80 0.421837
## Survey year2017:TreatmentModerate    -0.66048    0.19922   -3.32 0.000915 ***
## Survey year2018:TreatmentModerate    -0.41732    0.18937   -2.20 0.027541 *
## Survey year2019:TreatmentModerate     0.12377    0.17123    0.72 0.469795
## Survey year2017:TreatmentHeavy       -0.50332    0.19609   -2.57 0.010264 *
## Survey year2018:TreatmentHeavy       -0.60633    0.19231   -3.15 0.001617 **
## Survey year2019:TreatmentHeavy        0.07904    0.17233    0.46 0.646461
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

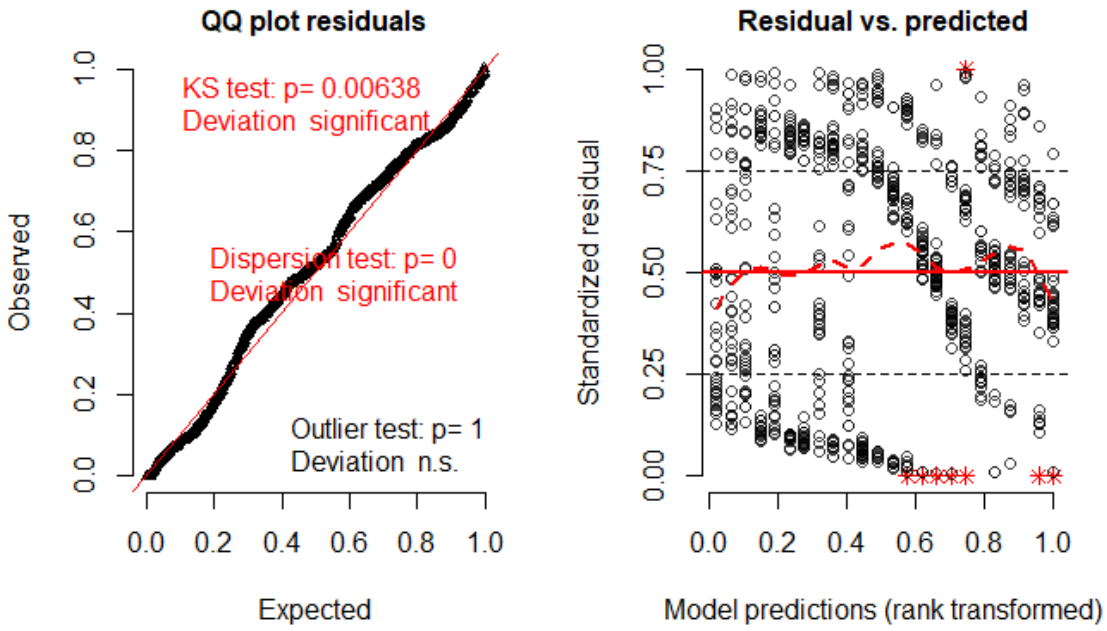


Figure 35 Dunn Smyth simulated residuals: dead elevated vegetation

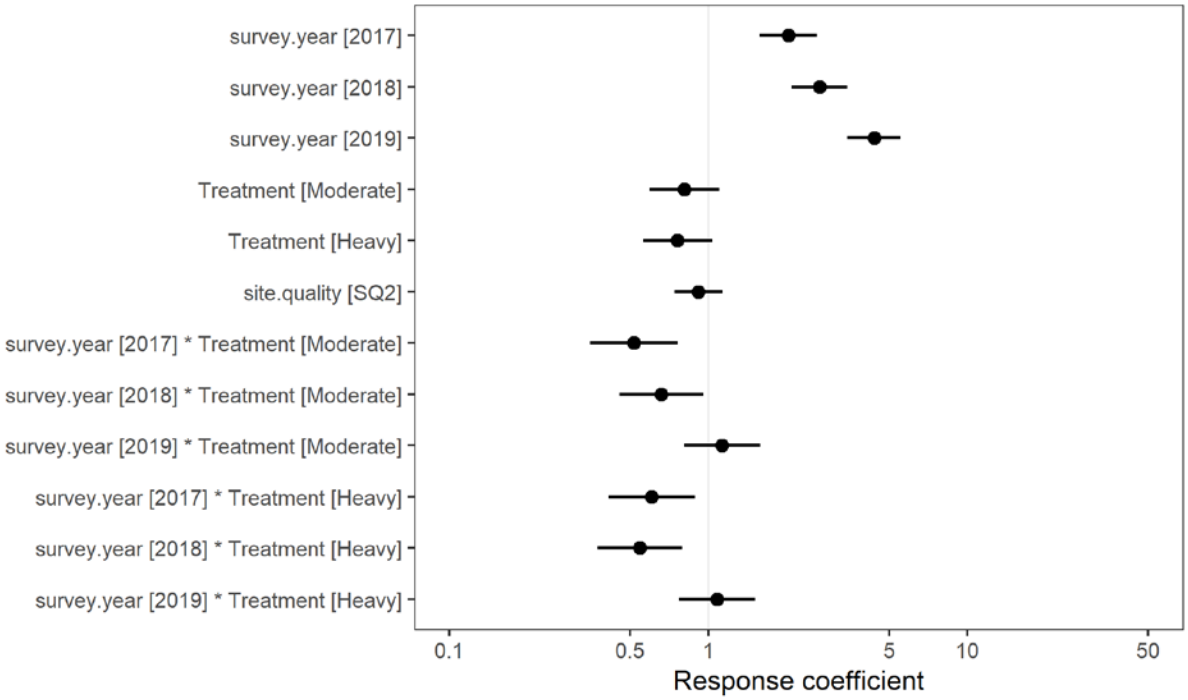


Figure 36 Wald confidence intervals for fixed effects: dead elevated vegetation cover

Table 37 Model fitted values for average conditions: dead elevated vegetation cover

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	0.2973	0.2362	0.2221
2017	SQ1	0.6145	0.2493	0.2765
2018	SQ1	0.8122	0.4276	0.3313
2019	SQ1	1.2841	1.2100	1.0901
2015	SQ2	0.2691	0.2137	0.2009
2017	SQ2	0.5575	0.2255	0.2502
2018	SQ2	0.7373	0.3875	0.3000
2019	SQ2	1.1667	1.0992	0.9900

E.5.3 Elevated fuel hazard assessment

Table 38 Model fitting summary: elevated fuel hazard

Response	Probability of being in each elevated fuel hazard category
Response transformation used	None
Other transformations compared	None
R package and function	brm from the brms package
Distribution used	Continuation ratio with flexible category thresholds – see explanation for overall fuel hazard above
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Not applicable
Confidence comments	Moderate

Model results summary 22: elevated fuel hazard

```
##  Family: cratio
##   Links: mu = logit; disc = identity
## Formula: risk.elev.or ~ Survey year * Treatment + Site quality + (1 | fsiteplot
) + (1 | fsite)
##    Data: DAT.fire (Number of observations: 795)
## Samples: 4 chains, each with iter = 2000; warmup = 1000; thin = 1;
##          total post-warmup samples = 4000
##
## Group-Level Effects:
## ~fsite (Number of levels: 22)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.34      0.20     0.02     0.76 1.00      633     1244
##
## ~fsiteplot (Number of levels: 66)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.62      0.17     0.25     0.96 1.00     1079     1481
##
## Population-Level Effects:
##                                   Estimate Est.Error l-95% CI u-95% CI Rhat
## Intercept[1]                          5.34      1.37     3.25     8.65 1.01
## Intercept[2]                         10.63      1.58     8.03    14.27 1.01
## Survey year2017                       4.37      1.39     2.28     7.65 1.01
## Survey year2018                       4.67      1.38     2.53     7.92 1.01
## Survey year2019                       4.66      1.39     2.56     8.01 1.01
## TreatmentModerate                     2.29      1.46     0.01     5.68 1.01
## TreatmentHeavy                        1.15      1.62    -1.67     4.69 1.01
## Site qualitySQ2                       0.48      0.28    -0.07     1.04 1.00
## Survey year2017:TreatmentModerate    -2.14      1.51    -5.61     0.30 1.01
## Survey year2018:TreatmentModerate    -1.82      1.49    -5.22     0.57 1.01
## Survey year2019:TreatmentModerate    -2.72      1.50    -6.19    -0.24 1.01
## Survey year2017:TreatmentHeavy       -0.41      1.65    -3.88     2.51 1.01
## Survey year2018:TreatmentHeavy       -0.50      1.64    -4.10     2.46 1.01
## Survey year2019:TreatmentHeavy       -1.21      1.65    -4.67     1.74 1.01
##                                   Bulk_ESS Tail_ESS
## Intercept[1]                           497      651
## Intercept[2]                           617      705
## Survey year2017                        492      675
## Survey year2018                        490      660
## Survey year2019                        502      599
## TreatmentModerate                      517      587
## TreatmentHeavy                         521      706
## Site qualitySQ2                       3917     2545
## Survey year2017:TreatmentModerate      520      634
## Survey year2018:TreatmentModerate      513      675
## Survey year2019:TreatmentModerate      537      650
## Survey year2017:TreatmentHeavy         537      665
## Survey year2018:TreatmentHeavy         526      668
## Survey year2019:TreatmentHeavy         526      690
##
## Samples were drawn using sampling(NUTS). For each parameter, Bulk_ESS
## and Tail_ESS are effective sample size measures, and Rhat is the potential
## scale reduction factor on split chains (at convergence, Rhat = 1).
```

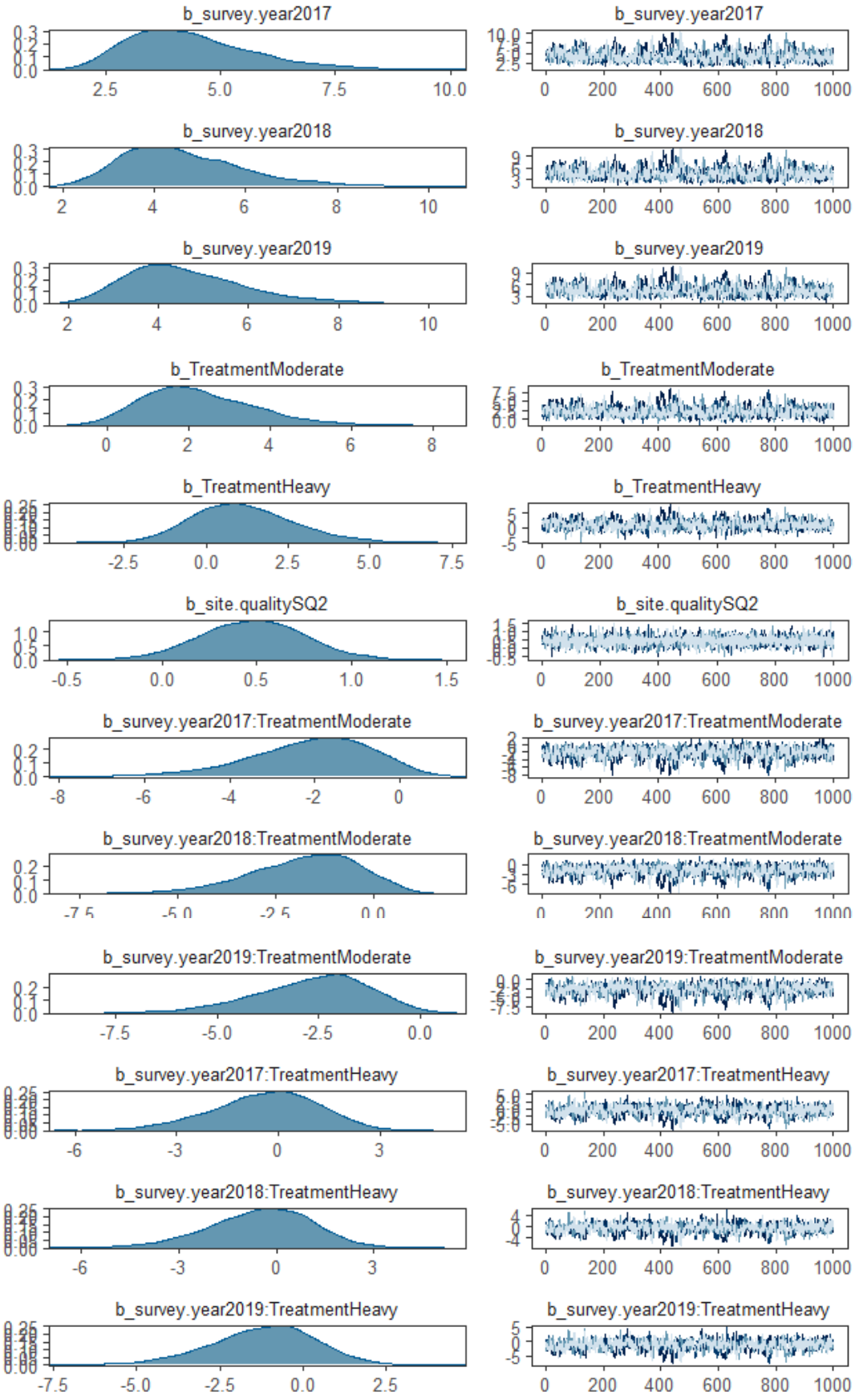


Figure 37 Posterior distributions (left) and chain mixing (right): elevated fuel hazard

Appendix F: Model summaries – Floristic composition

F.1 Plant species richness

F.1.1 Native plant species richness

Table 39 Model fitting summary: native plant species richness

Response	Number of native plant species recorded in each 0.04 each subplot
Response transformation used	None
Other transformations compared	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	Negative binomial Poisson
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year Also trialled a model with three-way interaction between thinning treatment, survey year and site quality, which was less parsimonious
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Marginal = 5.9% Conditional = 42.0%
Confidence comments	High. Passed all Dunn Smyth tests

Model results summary 23: native plant species richness

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: nat.richness ~ year * Treatment + Site quality + (1 | fsiteplot) +
##     (1 | fsite)
##    Data: DAT.native.subplot
##
## REML criterion at convergence: 4512.6
##
```

```
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.2431 -0.6820 -0.0253  0.6847  3.0620
##
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  fsiteplot (Intercept)  2.559   1.600
##  fsite     (Intercept)  6.956   2.637
##  Residual               15.277   3.909
## Number of obs: 795, groups:  fsiteplot, 66; fsite, 22
##
## Fixed effects:
##                             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)                  16.0324     1.0189  37.9885  15.735   <2e-16 ***
## year2017                      1.6970     0.6804 720.4346   2.494   0.0129 *
## year2018                     -0.7273     0.6804 720.4346  -1.069   0.2855
## year2019                     -0.7576     0.6804 720.4346  -1.113   0.2659
## TreatmentModerate             0.2879     0.8340 159.9892   0.345   0.7304
## TreatmentHeavy               -0.6293     0.8321 158.6163  -0.756   0.4506
## Site qualitySQ2              -0.3678     1.2234  19.9945  -0.301   0.7668
## year2017:TreatmentModerate    0.9091     0.9622 720.4346   0.945   0.3451
## year2018:TreatmentModerate    0.4848     0.9622 720.4346   0.504   0.6145
## year2019:TreatmentModerate    1.4697     0.9622 720.4346   1.527   0.1271
## year2017:TreatmentHeavy       1.8254     0.9586 720.4346   1.904   0.0573 .
## year2018:TreatmentHeavy       1.9362     0.9586 720.4346   2.020   0.0438 *
## year2019:TreatmentHeavy       1.3415     0.9605 720.5062   1.397   0.1630
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

##
## Correlation matrix not shown by default, as p = 13 > 12.
## Use print(x, correlation=TRUE)  or
##     vcov(x)        if you need it
```

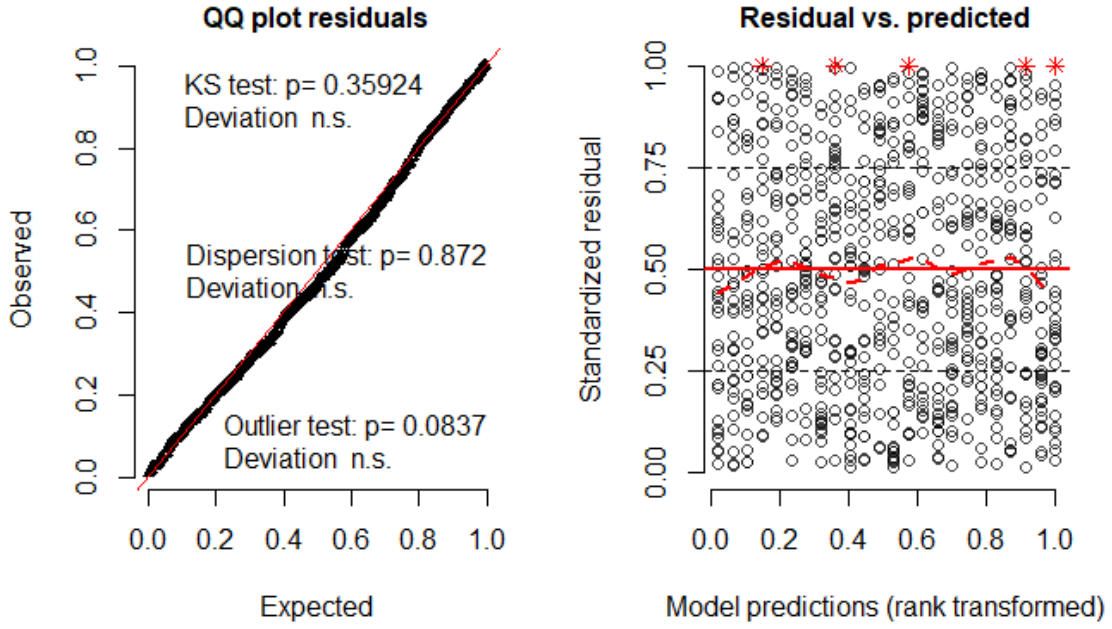


Figure 38 Dunn Smyth simulated residuals: native plant species richness

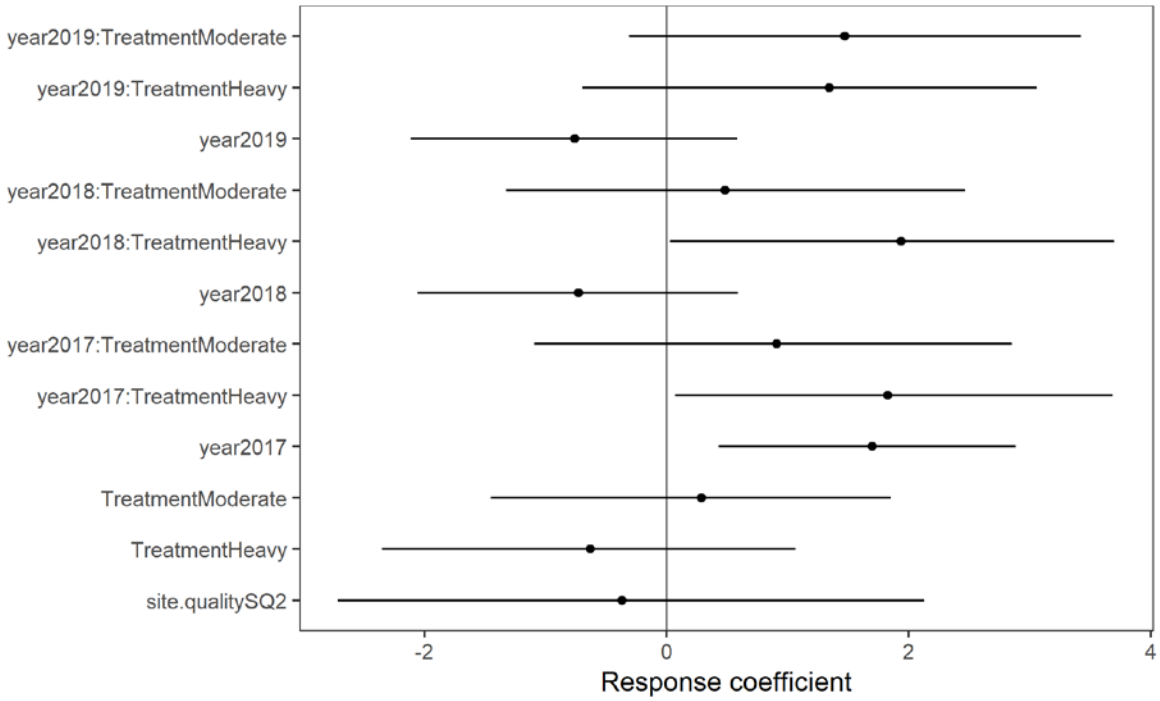


Figure 39 Bootstrapped confidence intervals for fixed effects: native plant species richness

Table 40 Bootstrapped model fitted values for average conditions: native plant species richness

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	16.1329	16.3468	15.5287
2017	SQ1	17.5436	18.8440	18.8474
2018	SQ1	15.1662	15.8765	16.7255
2019	SQ1	14.9979	16.7932	16.2540
2015	SQ2	15.4443	16.0166	15.0460
2017	SQ2	17.2464	18.8272	18.4186
2018	SQ2	15.3681	15.6262	16.4142
2019	SQ2	14.9887	16.8863	15.4330

F.1.2 Exotic plant species richness

Table 41 Model fitting summary: exotic plant species richness

Response	Number of exotic plant species recorded in each 0.04 each subplot
Response transformation used	None
Other transformations compared	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	None
Outliers removed	Five values with exotic richness above 18 species per subplot
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year Also trialled a model with three-way interaction between thinning treatment, survey year and site quality, which was less parsimonious
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Marginal = 5.5% Conditional = 45.5%
Confidence comments	High. Passed all Dunn Smyth tests

Model results summary 24: exotic plant species richness

```
DAT.exot.subplot1 <- DAT.exot.subplot %>%
  filter(exot.richness <18) # excludes 5 values

model.exot.rich <- lmer(exot.richness ~ year * Treatment + Site quality + (1|fsite
plot) + (1|fsite), data = DAT.exot.subplot1)

summary(model.exot.rich)

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: exot.richness ~ year * Treatment + Site quality + (1 | fsiteplot) +
##     (1 | fsite)
##    Data: DAT.exot.subplot1
##
## REML criterion at convergence: 3720.8
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.8099 -0.6751 -0.0513  0.5897  3.3235
##
```

```
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  fsiteplot (Intercept) 1.434    1.197
##  fsite     (Intercept) 3.770    1.942
##  Residual              7.094    2.663
## Number of obs: 754, groups:  fsiteplot, 66; fsite, 22
##
## Fixed effects:
##                             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)                   5.8585     0.7487  37.6084   7.825 2.08e-09 ***
## year2017                      0.7769     0.4840 682.9341   1.605  0.10894
## year2018                     -0.7572     0.4962 687.5435  -1.526  0.12743
## year2019                      0.2896     0.4879 687.2757   0.594  0.55304
## TreatmentModerate            -0.5604     0.6082 152.3110  -0.921  0.35828
## TreatmentHeavy               -0.2922     0.5987 144.9401  -0.488  0.62627
## Site qualitySQ2               0.3251     0.9004  19.9581   0.361  0.72186
## year2017:TreatmentModerate    1.1547     0.6804 682.4435   1.697  0.09013 .
## year2018:TreatmentModerate    1.4788     0.6902 685.0586   2.143  0.03250 *
## year2019:TreatmentModerate    1.5102     0.6843 684.9251   2.207  0.02764 *
## year2017:TreatmentHeavy       1.7733     0.6733 681.5880   2.634  0.00864 **
## year2018:TreatmentHeavy       1.7537     0.6792 683.7054   2.582  0.01003 *
## year2019:TreatmentHeavy       0.7688     0.6746 683.3419   1.140  0.25480
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

##
## Correlation matrix not shown by default, as p = 13 > 12.
## Use print(x, correlation=TRUE)  or
##     vcov(x)        if you need it
```

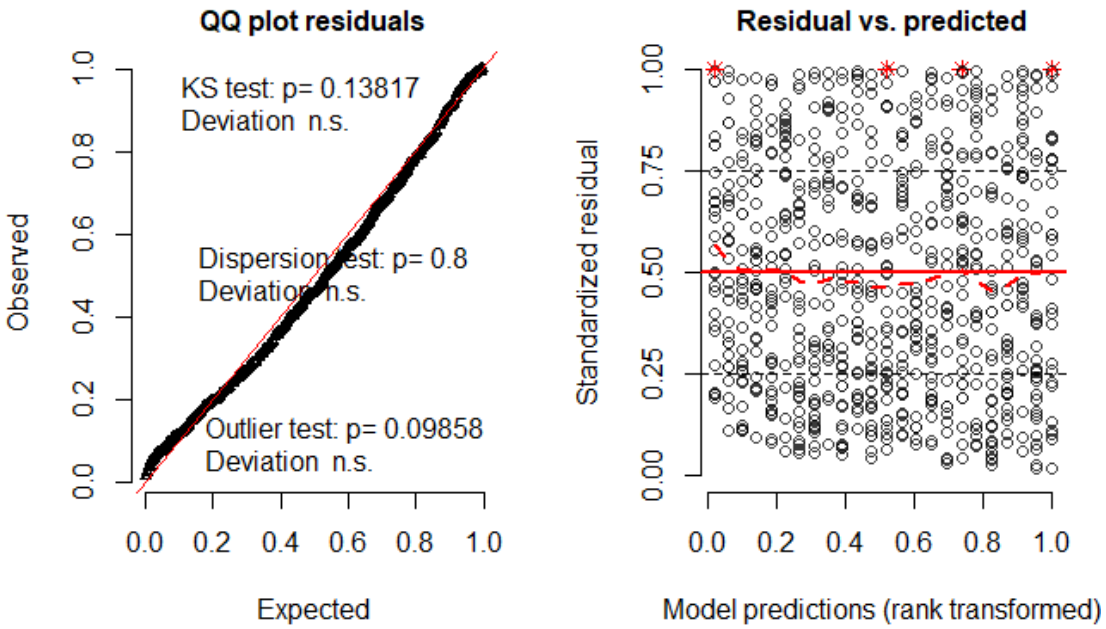


Figure 40 Dunn Smyth simulated residuals: exotic plant species richness

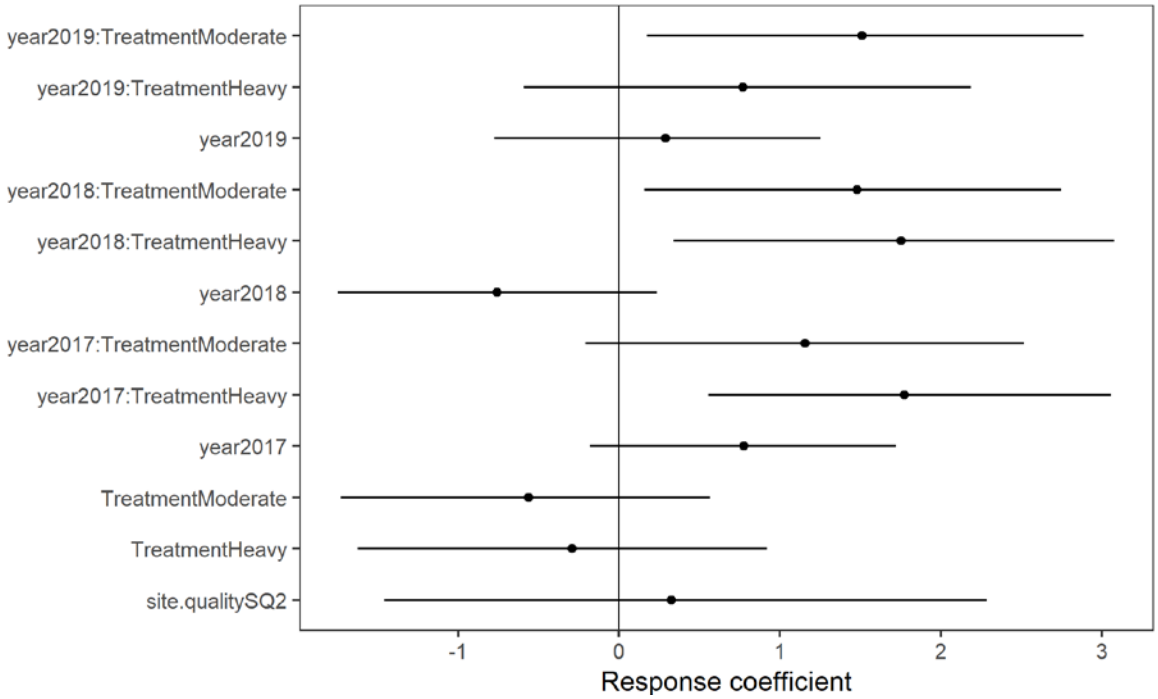


Figure 41 Bootstrapped confidence intervals for fixed effects: exotic plant species richness

Table 42 Bootstrapped model fitted values for average conditions: exotic plant species richness

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	5.8783	5.1355	5.6806
2017	SQ1	6.3297	7.2717	8.0660
2018	SQ1	5.0661	5.8675	6.4717
2019	SQ1	6.2661	7.0983	6.2892
2015	SQ2	6.3199	5.7048	5.7941
2017	SQ2	6.7575	7.3935	8.3589
2018	SQ2	5.5951	6.2714	6.9540
2019	SQ2	6.4315	7.4781	6.9973

F.2 Plant cover

F.2.1 Native plant cover

Table 43 Model fitting summary: native plant cover

Response	Native plant vegetation cover, visually estimated in each 0.04 ha subplot in 2019 only
Response transformation used	Rounding % cover to nearest whole value
Response transformations compared	$Log_e(x+1)$ transformation attempted on gaussian model (X+0.1)/100 transformation attempted on beta model
R package and function	glmer function from the lme4 package
Distribution used	Binomial with percentage values rounded up to the nearest 1%
Other distributions compared	Gaussian Beta
Outliers removed	Five values >15% were removed
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and site quality
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Marginal = 2.9% Conditional = 9.5%
Confidence comments	Low. Failed the uniformity test, some under-dispersion in the data, meaning more data than expected fall in the tails of the data

Model results summary 25: native plant cover

```
za <-cbind(success = ceiling(DAT.cover.b$nat.live), failure = 100- ceiling(DAT.cov
er.b$nat.live))

model.native.binom.b <- glmer(za ~ Site quality * Treatment + (1|fsite) + (1|fsite
plot),
                              data = DAT.cover.b, family = "binomial", glmerControl(
optimizer = "bobyqa"))

summary(model.native.binom.b)

## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: za ~ Site quality * Treatment + (1 | fsite) + (1 | fsiteplot)
##    Data: DAT.cover.b
## Control: glmerControl(optimizer = "bobyqa")
##
##      AIC      BIC   logLik deviance df.resid
##    687.1    713.1   -335.5    671.1      184
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.6624 -0.4601 -0.2319  0.0470  3.9940
##
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  fsiteplot (Intercept) 0.20007  0.4473
##  fsite     (Intercept) 0.03882  0.1970
## Number of obs: 192, groups:  fsiteplot, 65; fsite, 22
##
## Fixed effects:
##                                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)                        -3.5129     0.1825 -19.251   <2e-16 ***
## Site qualitySQ2                    -0.6324     0.2715  -2.329   0.0198 *
## TreatmentModerate                  -0.0693     0.2514  -0.276   0.7829
## TreatmentHeavy                     -0.5369     0.2545  -2.109   0.0349 *
## Site qualitySQ2:TreatmentModerate  -0.1315     0.3761  -0.350   0.7266
## Site qualitySQ2:TreatmentHeavy      0.3866     0.3766   1.026   0.3047
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

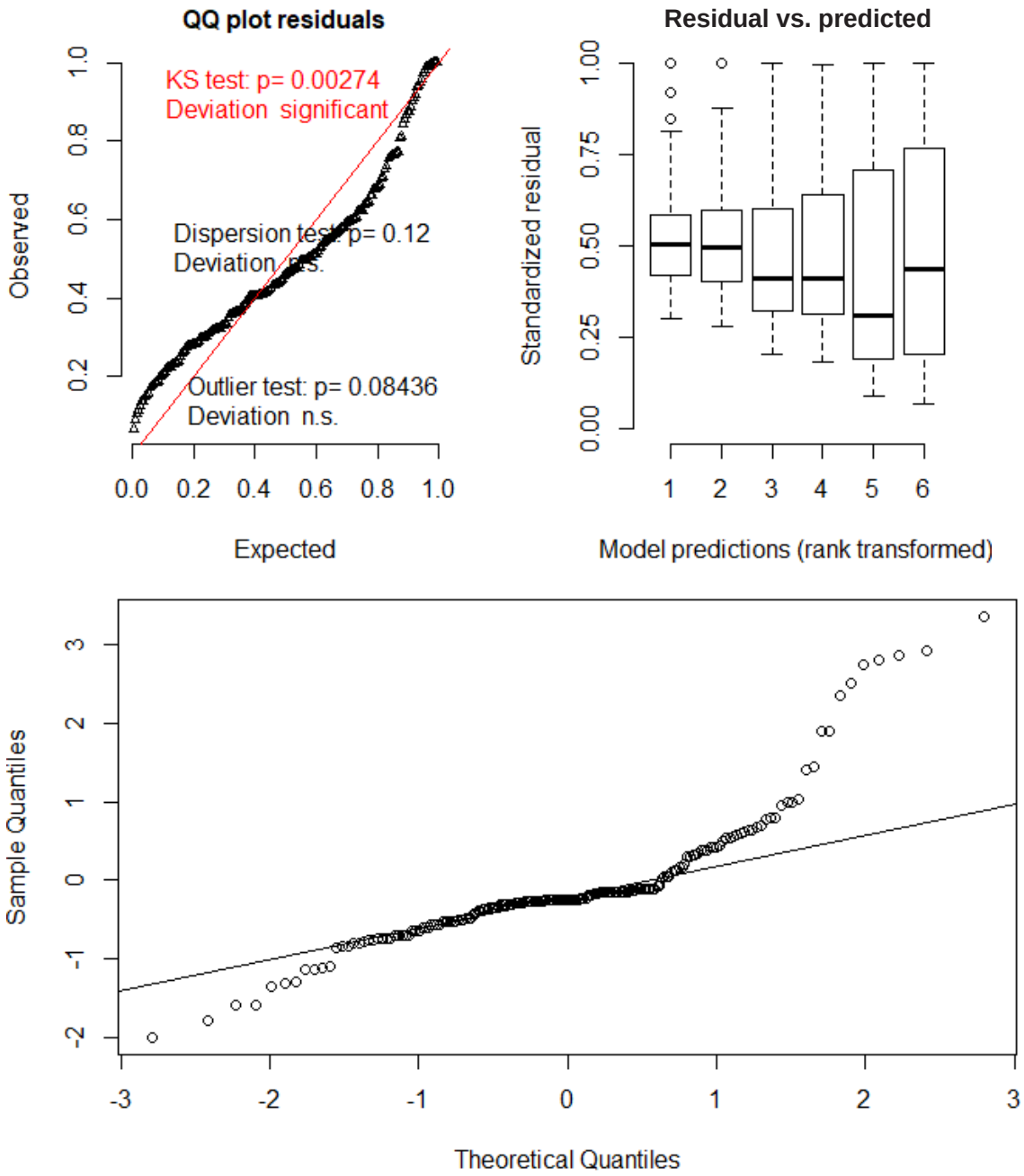


Figure 42 Dunn Smyth simulated residuals (top panels) and normal QQ plot (bottom panel): native plant cover

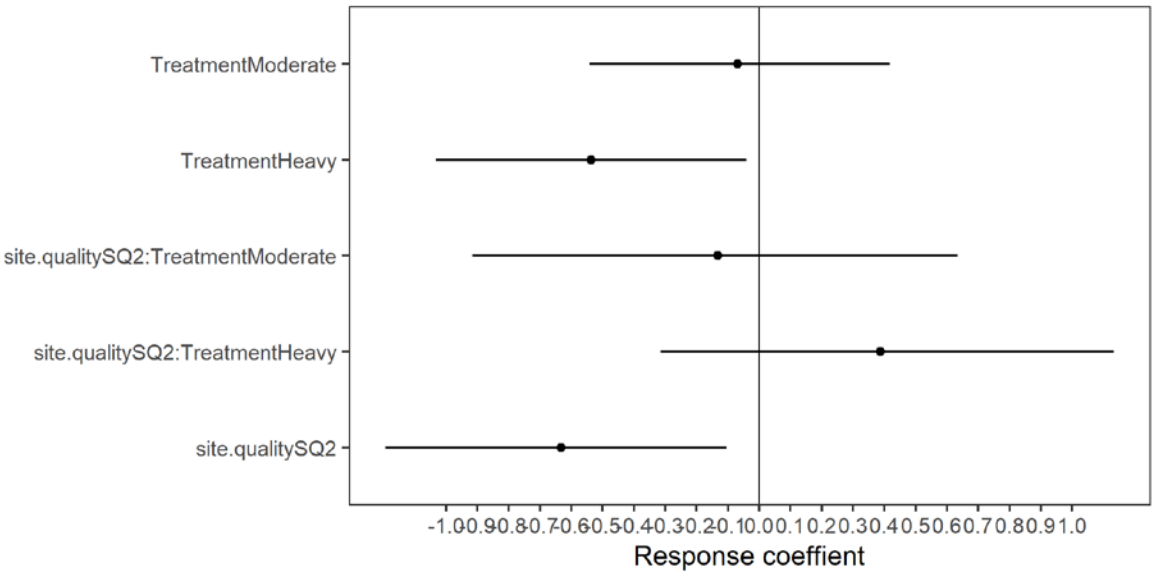


Figure 43 Bootstrapped confidence intervals for fixed effects: native plant cover

Table 44 Bootstrapped model fitted values for average conditions: native plant cover

Survey year	Site quality	Control	Moderate	Heavy
2019	SQ1	2.8519	3.0232	1.7330
2019	SQ2	1.5776	1.2686	1.3522

F.2.2 Exotic plant cover

Table 45 Model fitting summary: exotic plant cover

Response	Exotic plant cover, visually estimated in each 0.04 ha subplot
Response transformation used	Rounding % cover up to nearest whole value
Other transformations compared	$Log_e(x+1)$ transformation attempted on gaussian model (X+0.1)/100 transformation attempted on beta model
R package and function	glmer function from the lme4 package
Distribution used	Binomial with data rounded up to nearest whole %
Other distributions compared	Gaussian Beta
Outliers removed	One value >13% was removed
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Site quality (SQ1, SQ2)
Fixed factor interactions	Two-way interaction between thinning treatment and site quality
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Marginal = 1.1% Conditional = 7.2%
Confidence comments	Very low. Failed Dunn Smyth uniformity and dispersion tests

Model results summary 26: exotic plant cover

```
y <-cbind(success = ceiling(DAT.cover.a$exot.live), failure = 100- ceiling(DAT.cov
er.a$exot.live))

model.exotic.binom <- glmer(y ~ Site quality * Treatment + (1|fsite) + (1|fsiteplo
t),
                            data = DAT.cover.a, family = "binomial")

summary(model.exotic.binom)

## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: y ~ Site quality * Treatment + (1 | fsite) + (1 | fsiteplot)
##    Data: DAT.cover.a
##
##      AIC      BIC   logLik deviance df.resid
##    582.6    608.8   -283.3    566.6      188
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.2832 -0.3282 -0.0628  0.0581  4.2551
```

```
##
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  fsiteplot (Intercept) 0.03727  0.1930
##  fsite     (Intercept) 0.18197  0.4266
## Number of obs: 196, groups:  fsiteplot, 66; fsite, 22
##
## Fixed effects:
##                                    Estimate Std. Error z value Pr(>|z|)
## (Intercept)                        -4.44026    0.21159 -20.985   <2e-16 ***
## Site qualitySQ2                     0.30941    0.28840   1.073   0.2833
## TreatmentModerate                  -0.05626    0.23856  -0.236   0.8136
## TreatmentHeavy                      0.44308    0.21693   2.043   0.0411 *
## Site qualitySQ2:TreatmentModerate -0.31753    0.32679  -0.972   0.3312
## Site qualitySQ2:TreatmentHeavy    -0.72038    0.31131  -2.314   0.0207 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

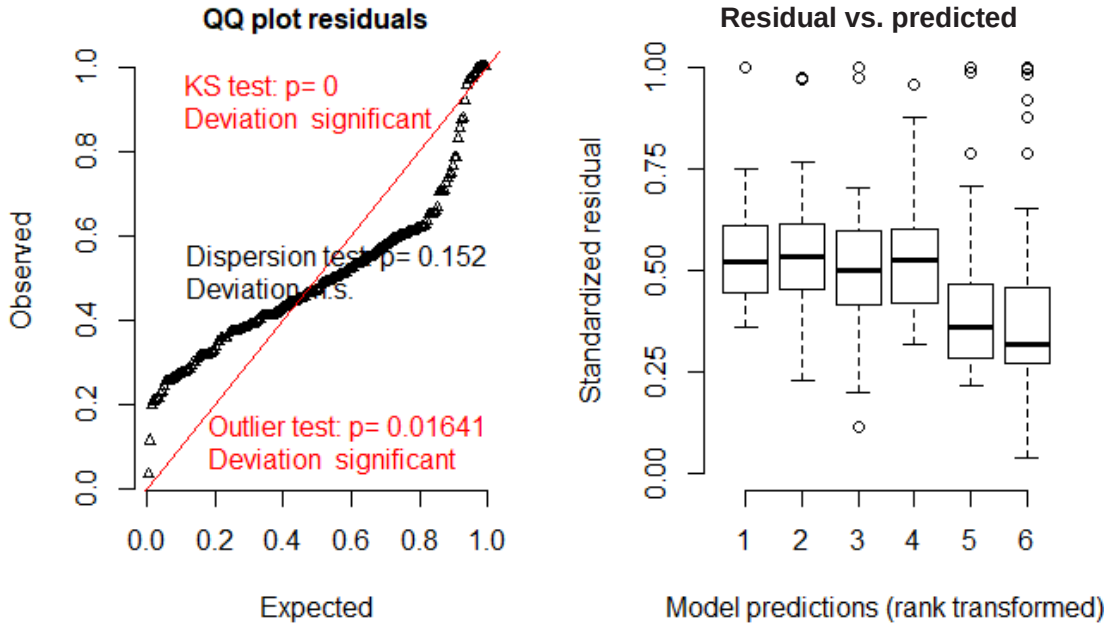


Figure 44 Dunn Smyth simulated residuals: exotic plant cover

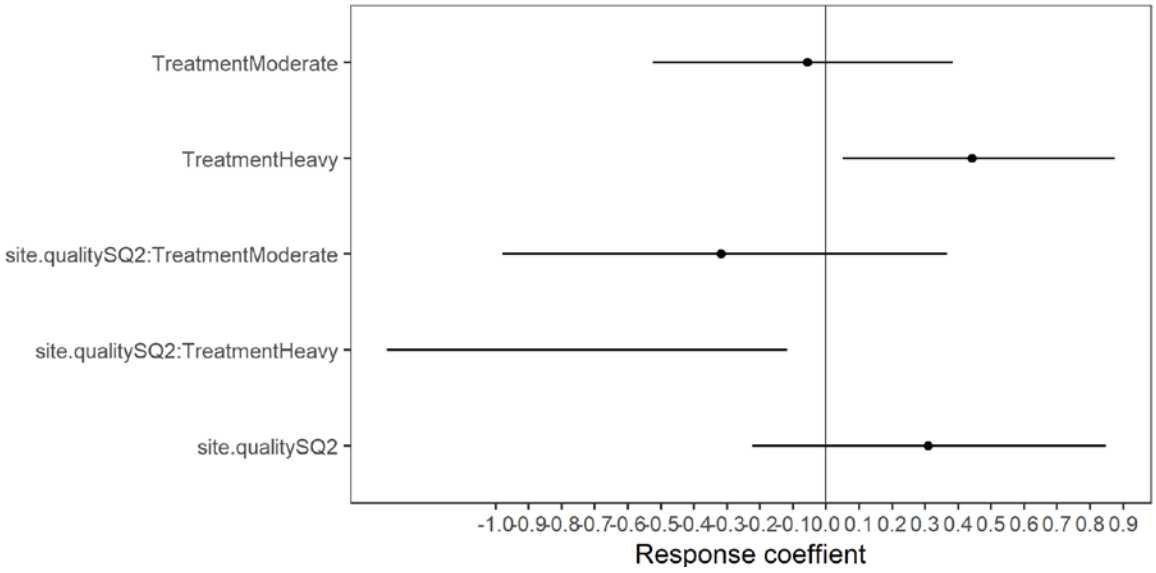


Figure 45 Bootstrapped confidence intervals for fixed effects: exotic plant cover

Table 46 Bootstrapped model fitted values for average conditions: exotic plant cover

Survey year	Site quality	Control	Moderate	Heavy
2019	SQ1	1.2082	1.1428	1.8419
2019	SQ2	1.6823	1.0634	1.2668

F.3 Floristic community composition 2019–20

This is done by using vegdist and hclust from the vegan package.

F.4 Threatened plant species

No models were run for threatened plant species.

Appendix G: Model summaries – Birds

G.1 Bird species richness

Table 47 Model fitting summary: bird species richness

Response	Number of bird species recorded in a 2 ha subplot in each 9 ha plot A positive continuous variable
Response transformation used	None
Other transformations compared	None
R package and function	lmer function from lme4 package
Distribution used	Gaussian
Other distributions compared	None
Outliers removed	None
Fixed factors	Ecological thinning treatment (control, moderate, heavy) Survey year (2015, 2017, 2018, 2019) Site quality (SQ1, SQ2)
Fixed factor interactions	Interaction between thinning treatment and survey year Also trialled a model with three-way interaction between thinning treatment, survey year and site quality, which was less parsimonious
Random factors	fsite (a factor over sites), and fsiteplot (a factor over 9 ha treatment plots nested within site)
R^2	Marginal = 5.8% Conditional = 54.5%
Confidence comments	High. Passed all Dunn Smyth tests

Model results summary 27: bird species richness

```
model.rich3 <- lmer(richness ~ year * Treatment * Site quality + (1|siteplot) + (1
|site), data = DAT.richness)

summary(model.rich)

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: richness ~ year * Treatment + Site quality + (1 | siteplot) +
##     (1 | site)
##    Data: DAT.richness
##
## REML criterion at convergence: 1386.2
##
```

```
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.02929 -0.64965  0.01828  0.64300  2.37681
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  siteplot (Intercept) 2.571    1.603
##  site     (Intercept) 7.073    2.660
##  Residual             9.006    3.001
## Number of obs: 264, groups:  siteplot, 66; site, 22
##
## Fixed effects:
##                              Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)                   20.8826     1.1146  48.0100  18.736  < 2e-16 ***
## year2017                      -2.6364     0.9048 189.0000  -2.914 0.004003 **
## year2018                      -3.8636     0.9048 189.0000  -4.270 3.09e-05 ***
## year2019                      -3.5909     0.9048 189.0000  -3.969 0.000103 ***
## TreatmentModerate             -1.8636     1.0259 168.5657  -1.817 0.071052 .
## TreatmentHeavy                -1.7727     1.0259 168.5657  -1.728 0.085819 .
## Site qualitySQ2               -0.6742     1.2563  20.0000  -0.537 0.597408
## year2017:TreatmentModerate     2.6818     1.2796 189.0000   2.096 0.037433 *
## year2018:TreatmentModerate     2.3182     1.2796 189.0000   1.812 0.071634 .
## year2019:TreatmentModerate     3.7273     1.2796 189.0000   2.913 0.004014 **
## year2017:TreatmentHeavy        2.5909     1.2796 189.0000   2.025 0.044301 *
## year2018:TreatmentHeavy        3.4545     1.2796 189.0000   2.700 0.007571 **
## year2019:TreatmentHeavy        2.5455     1.2796 189.0000   1.989 0.048120 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

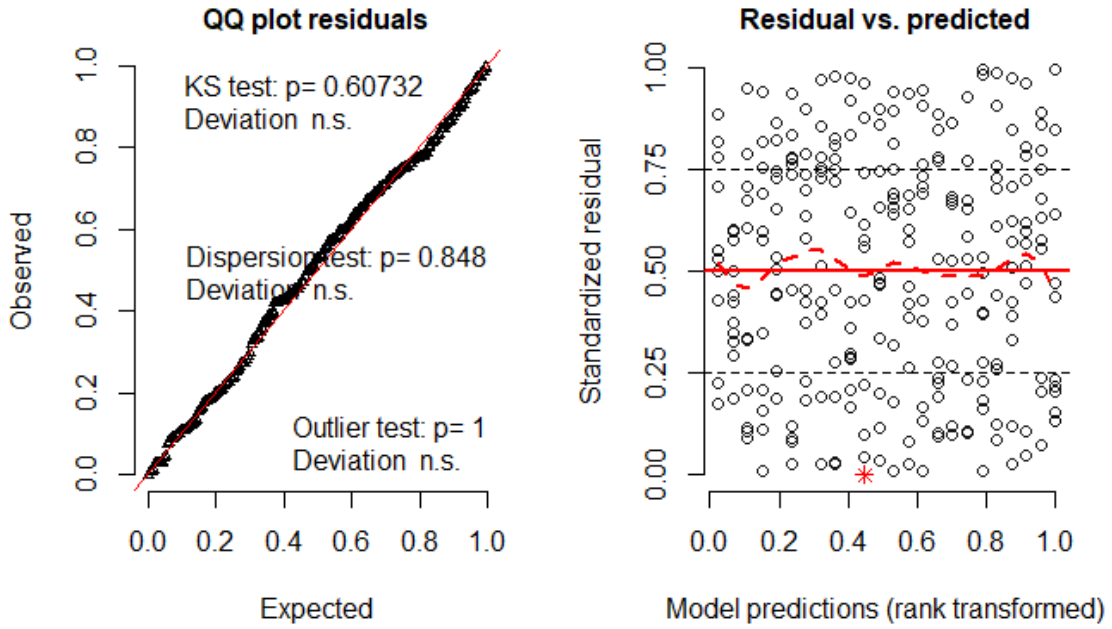


Figure 46 Dunn Smyth simulated residuals: bird species richness

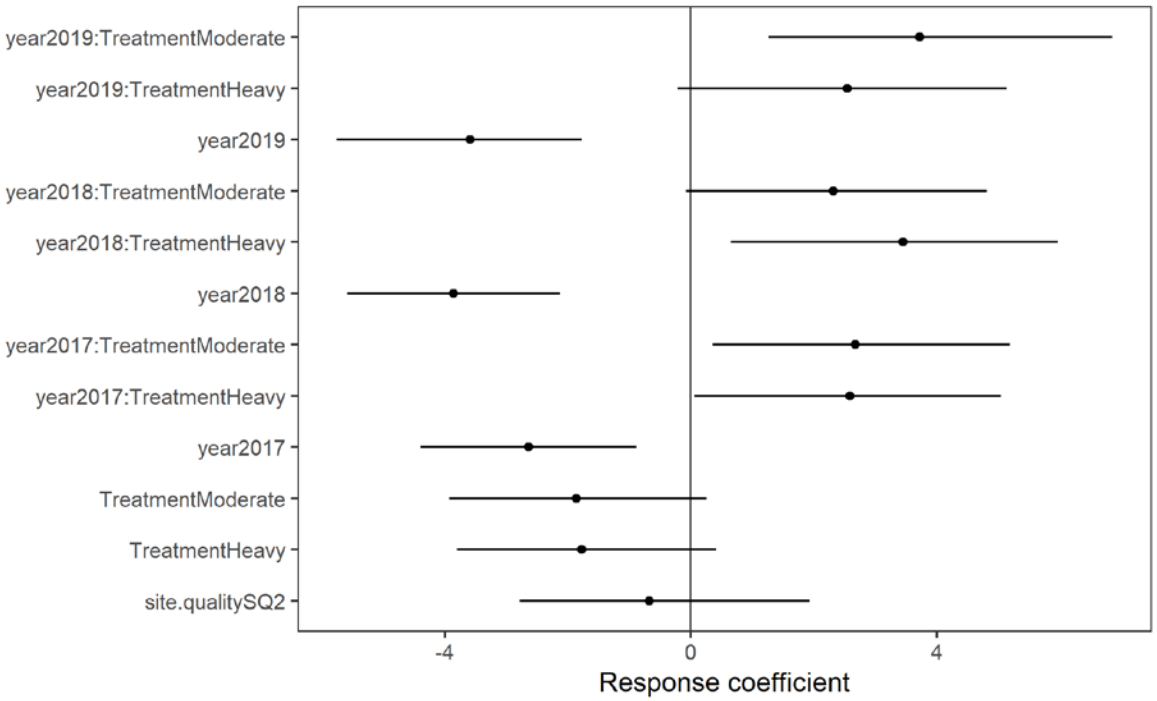


Figure 47 Bootstrapped confidence intervals for fixed effects: bird species richness

Table 48 Bootstrapped model fitted values for average conditions: bird species richness

Survey year	Site quality	Control	Moderate	Heavy
2015	SQ1	20.95207	18.81166	19.09551
2017	SQ1	18.21164	19.12331	19.18590
2018	SQ1	17.20485	17.26662	18.56651
2019	SQ1	17.17184	19.03193	18.19858
2015	SQ2	20.16336	18.40424	18.39405
2017	SQ2	17.49041	18.43281	18.28559
2018	SQ2	16.28156	16.87681	17.91971
2019	SQ2	16.78246	18.44013	17.50177

G.2 Bird community composition

G.2.1 Bird community composition 2019–20

See plant community composition above.

G.3 Threatened bird species

No models were run.

Appendix H: Model summaries – Bats

H.1 Overall bat activity

Table 49 Model fitting summary: overall bat activity

Response	Total activity of all bat species
Response transformation	None
R package and function	glmer function from lme4 package
Distribution used	Poisson
Other distributions compared	None
Outliers removed	None
Fixed factors	Year (2015, 2017, 2018, 2019 and 2020) Thinning treatment (control, moderate and heavy) Site quality (SQ1 and SQ2) Temperature (log of monthly maximum and minimum) and Foliage projective cover (logit)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	plot (a factor over 9 ha treatment plots)
R^2	Marginal = 24.5% Conditional = 47.2%
Confidence comments	Moderate – based on R2 only

Model results summary 28: overall bat activity

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation)
['glmerMod']
 Family: poisson  ( log )
Formula: Activity ~ Year * Treatment + log(MaxTemp) + log(MinTemp) + qlogis(FPC) +
SQ + (1 | Plot)
   Data: Batact

     AIC      BIC   logLik deviance df.resid
 63271.6  63368.6 -31615.8  63231.6      924

Scaled residuals:
    Min      1Q  Median      3Q     Max
-15.369  -5.696  -1.310   4.116  44.721

Random effects:
 Groups Name        Variance Std.Dev.
 Plot   (Intercept) 0.2024   0.4498
Number of obs: 944, groups:  Plot, 66
```

```
Fixed effects:
                            Estimate Std. Error z value Pr(>|z|)
(Intercept)                  0.13628    0.11634   1.171    0.241
YearY2017                   -0.29866    0.01482 -20.146  < 2e-16 ***
YearY2018                   -0.12897    0.01193 -10.807  < 2e-16 ***
YearY2019                   -0.43427    0.01208 -35.964  < 2e-16 ***
YearY2020                   -0.24882    0.01217 -20.453  < 2e-16 ***
TreatmentModerate           -0.11424    0.13615  -0.839    0.401
TreatmentHeavy              -0.01185    0.13612  -0.087    0.931
log(MaxTemp)                 1.17864    0.02017  58.436  < 2e-16 ***
log(MinTemp)                 0.53618    0.01013  52.943  < 2e-16 ***
qlogis(FPC)                  0.19255    0.00879  21.907  < 2e-16 ***
SQSQ2                       -0.23136    0.05767  -4.012 6.03e-05 ***
YearY2017:TreatmentModerate  0.19468    0.01907  10.210  < 2e-16 ***
YearY2018:TreatmentModerate  0.21171    0.01630  12.992  < 2e-16 ***
YearY2019:TreatmentModerate  0.30104    0.01711  17.594  < 2e-16 ***
YearY2020:TreatmentModerate  0.38878    0.01695  22.935  < 2e-16 ***
YearY2017:TreatmentHeavy     0.12462    0.01791   6.960 3.40e-12 ***
YearY2018:TreatmentHeavy     0.39766    0.01570  25.329  < 2e-16 ***
YearY2019:TreatmentHeavy     0.38984    0.01651  23.606  < 2e-16 ***
YearY2020:TreatmentHeavy     0.48772    0.01640  29.739  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.2 Bat guild activity

H.2.1 Clutter specialists

Table 50 Model fitting summary: clutter specialist bat activity

Response	Total activity of clutter specialist bat species (*Nyctophilus* spp.)
Response transformation	None
R package and function	glmer function from lme4 package
Distribution used	Poisson
Other distributions compared	None
Outliers removed	None
Fixed factors	Year (2015, 2017, 2018, 2019 and 2020) Thinning treatment (control, moderate and heavy) Site quality (SQ1 and SQ2) Temperature (log of monthly maximum and minimum) and Foliage projective cover (logit)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	plot (a factor over 9 ha treatment plots)
R^2	Marginal = 51.8% Conditional = 56.4%
Confidence comments	Moderate – based on R^2 only

Model results summary 29: clutter specialist activity

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [
'glmerMod']
 Family: poisson  ( log )
Formula: Nyct ~ Year * Treatment + log(MaxTemp) + log(MinTemp) + qlogis(FPC) +
SQ + (1 | Plot)
   Data: Batact

     AIC      BIC   logLik deviance df.resid
  9411.9   9508.9  -4685.9   9371.9      924

Scaled residuals:
    Min      1Q  Median      3Q     Max
-8.6559 -1.2750 -0.4383  1.1391 27.9726

Random effects:
 Groups Name        Variance Std.Dev.
 Plot   (Intercept) 0.3      0.5477
Number of obs: 944, groups:  Plot, 66
```

```
Fixed effects:
                                Estimate Std. Error z value Pr(>|z|)
(Intercept)                    1.0803394  0.3691207   2.927  0.00342 **
YearY2017                     -0.5224918  0.0609765  -8.569  < 2e-16 ***
YearY2018                     -2.5263292  0.1006523 -25.100  < 2e-16 ***
YearY2019                     -0.3136451  0.0441283  -7.108 1.18e-12 ***
YearY2020                     -2.2014423  0.0833958 -26.398  < 2e-16 ***
TreatmentModerate              0.4174611  0.1708359   2.444  0.01454 *
TreatmentHeavy                 0.0002503  0.1716795   0.001  0.99884
log(MaxTemp)                   0.2261857  0.1244154   1.818  0.06907 .
log(MinTemp)                   0.4765382  0.0531537   8.965  < 2e-16 ***
qlogis(FPC)                    0.2383790  0.0473708   5.032 4.85e-07 ***
SQSQ2                         -0.6469071  0.1393483  -4.642 3.44e-06 ***
YearY2017:TreatmentModerate -1.4923440  0.0841234 -17.740  < 2e-16 ***
YearY2018:TreatmentModerate -0.8863092  0.1570616  -5.643 1.67e-08 ***
YearY2019:TreatmentModerate -1.4488981  0.0674051 -21.495  < 2e-16 ***
YearY2020:TreatmentModerate -0.0794297  0.1128784  -0.704  0.48164
YearY2017:TreatmentHeavy    -0.6573912  0.0838766  -7.838 4.59e-15 ***
YearY2018:TreatmentHeavy     0.8166915  0.1291029   6.326 2.52e-10 ***
YearY2019:TreatmentHeavy    -0.4339134  0.0705192  -6.153 7.60e-10 ***
YearY2020:TreatmentHeavy     0.6143415  0.1168095   5.259 1.45e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.2.2 Clutter avoiders

Table 51 Model fitting summary: clutter avoider bat activity

Response	Total activity of clutter avoider species (all except *Nyctophilus* spp.)
Response transformation	None
R package and function	glmer function from lme4 package
Distribution used	Poisson
Other distributions compared	None
Outliers removed	None
Fixed factors	Year (2015, 2017, 2018, 2019 and 2020) Thinning treatment (control, moderate and heavy) Site quality (SQ1 and SQ2) Temperature (log of monthly maximum and minimum) and Foliage projective cover (logit)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	plot (a factor over 9 ha treatment plots)
R^2	Marginal = 24.6% Conditional = 47.1%
Confidence comments	Moderate – based on R^2 only

Model results summary 30: clutter avoider activity

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [
'glmerMod']
 Family: poisson  ( log )
Formula: NotNyct ~ Year * Treatment + log(MaxTemp) + log(MinTemp) + qlogis(FPC) +
SQ + (1 | Plot)
   Data: Batact

     AIC      BIC   logLik deviance df.resid
   62902    62999   -31431    62862      924

Scaled residuals:
    Min      1Q  Median      3Q     Max
-15.485  -5.486  -1.369   4.249  43.582

Random effects:
 Groups Name        Variance Std.Dev.
 Plot   (Intercept) 0.221    0.4702
Number of obs: 944, groups:  Plot, 66

Fixed effects:
                             Estimate Std. Error z value Pr(>|z|)
(Intercept)                 -0.214478   0.121008  -1.772  0.07632 .
YearY2017                   -0.260091   0.015516 -16.763  < 2e-16 ***
YearY2018                   -0.035786   0.012327  -2.903  0.00369 **
YearY2019                   -0.458655   0.012798 -35.838  < 2e-16 ***
YearY2020                   -0.162403   0.012517 -12.975  < 2e-16 ***
TreatmentModerate           -0.190176   0.142323  -1.336  0.18147
TreatmentHeavy               0.008272   0.142258   0.058  0.95363
log(MaxTemp)                 1.223343   0.020690  59.127  < 2e-16 ***
log(MinTemp)                 0.561030   0.010431  53.785  < 2e-16 ***
qlogis(FPC)                  0.167886   0.009107  18.435  < 2e-16 ***
SQSQ2                       -0.240431   0.058873  -4.084 4.43e-05 ***
YearY2017:TreatmentModerate  0.331633   0.019975  16.603  < 2e-16 ***
YearY2018:TreatmentModerate  0.284788   0.016976  16.776  < 2e-16 ***
YearY2019:TreatmentModerate  0.464586   0.018111  25.652  < 2e-16 ***
YearY2020:TreatmentModerate  0.446945   0.017627  25.355  < 2e-16 ***
YearY2017:TreatmentHeavy     0.157800   0.018589   8.489  < 2e-16 ***
YearY2018:TreatmentHeavy     0.366336   0.016178  22.644  < 2e-16 ***
YearY2019:TreatmentHeavy     0.449038   0.017282  25.983  < 2e-16 ***
YearY2020:TreatmentHeavy     0.457768   0.016843  27.179  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.3 Individual bat species

H.3.1 White-striped mastiff bat

Table 52 Model fitting summary: white-striped mastiff bat activity

Response	Total activity of white-striped mastiff bat
Response transformation	None
R package and function	glmer function from lme4 package
Distribution used	Poisson
Other distributions compared	None
Outliers removed	None
Fixed factors	Year (2015, 2017, 2018, 2019 and 2020) Thinning treatment (control, moderate and heavy) Site quality (SQ1 and SQ2) Temperature (log of monthly maximum and minimum) and Foliage projective cover (logit)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	plot (a factor over 9 ha treatment plots)
R^2	Marginal = 24.9% Conditional = 38.9%
Confidence comments	Moderate – based on R^2 only

Model results summary 31: white-striped mastiff bat activity

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [
'glmerMod']
 Family: poisson  ( log )
Formula: Taus ~ Year * Treatment + log(MaxTemp) + log(MinTemp) + qlogis(FPC) +
(1 | Plot)
   Data: Batact
Control: glmerControl(optimizer = "bobyqa", optCtrl = list(maxfun = 1e+05))

     AIC      BIC   logLik deviance df.resid
 15235.2  15327.4  -7598.6  15197.2      925

Scaled residuals:
   Min     1Q Median     3Q    Max
-7.084 -2.296 -1.066  1.311 21.954

Random effects:
 Groups Name        Variance Std.Dev.
 Plot   (Intercept) 0.3343   0.5782
Number of obs: 944, groups:  Plot, 66
```

```
Fixed effects:
                            Estimate Std. Error z value Pr(>|z|)
(Intercept)                -4.76805    0.29096 -16.387  < 2e-16 ***
YearY2017                  -1.14396    0.07720 -14.818  < 2e-16 ***
YearY2018                  -0.28921    0.04689  -6.168 6.90e-10 ***
YearY2019                  -1.22559    0.05416 -22.628  < 2e-16 ***
YearY2020                  -0.34234    0.04335  -7.896 2.87e-15 ***
TreatmentModerate          -0.47148    0.18053  -2.612  0.00901 **
TreatmentHeavy             -0.32741    0.17995  -1.819  0.06884 .
log(MaxTemp)                1.76636    0.08908  19.829  < 2e-16 ***
log(MinTemp)                0.43401    0.04434   9.788  < 2e-16 ***
qlogis(FPC)                -0.26652    0.03765  -7.080 1.44e-12 ***
YearY2017:TreatmentModerate  0.88613    0.09616   9.215  < 2e-16 ***
YearY2018:TreatmentModerate  0.16990    0.06688   2.540  0.01108 *
YearY2019:TreatmentModerate  1.25932    0.07242  17.388  < 2e-16 ***
YearY2020:TreatmentModerate  0.53995    0.06250   8.639  < 2e-16 ***
YearY2017:TreatmentHeavy     0.77790    0.09199   8.456  < 2e-16 ***
YearY2018:TreatmentHeavy     0.57415    0.06145   9.343  < 2e-16 ***
YearY2019:TreatmentHeavy     0.99716    0.07155  13.936  < 2e-16 ***
YearY2020:TreatmentHeavy     0.53654    0.06007   8.932  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

H.3.2 Large forest bat

Table 53 Model fitting summary: large forest bat activity

Response	Total activity of large forest bat
Response transformation	None
R package and function	glmer function from lme4 package
Distribution used	Poisson
Other distributions compared	None
Outliers removed	None
Fixed factors	Year (2015, 2017, 2018, 2019 and 2020) Thinning treatment (control, moderate and heavy) Site quality (SQ1 and SQ2) Temperature (log of monthly maximum and minimum) and Foliage projective cover (logit)
Fixed factor interactions	Two-way interaction between thinning treatment and survey year
Random factors	plot (a factor over 9 ha treatment plots)
R^2	Marginal = 16.7% Conditional = 44.6%
Confidence comments	Moderate – based on R^2 only

Model results summary 32: large forest bat activity

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation)
['glmerMod']
 Family: poisson  ( log )
Formula: Vdar ~ Year * Treatment + log(MaxTemp) + log(MinTemp) + qlogis(FPC) +
(1 | Plot)
   Data: Batact
Control: glmerControl(optimizer = "bobyqa", optCtrl = list(maxfun = 1e+05))

     AIC      BIC   logLik deviance df.resid
 10569.2  10661.3  -5265.6  10531.2      925

Scaled residuals:
    Min      1Q  Median      3Q     Max
-6.6025 -1.7146 -0.6637  1.0241 18.5381

Random effects:
 Groups Name        Variance Std.Dev.
 Plot   (Intercept) 0.7509   0.8666
Number of obs: 944, groups:  Plot, 66

Fixed effects:
                            Estimate Std. Error z value Pr(>|z|)
(Intercept)                -4.33555    0.36735 -11.802  < 2e-16 ***
YearY2017                  -0.43363    0.07869  -5.510 3.58e-08 ***
YearY2018                  -0.14312    0.07143  -2.004 0.045123 *
YearY2019                  -0.29834    0.07512  -3.972 7.14e-05 ***
YearY2020                  -0.07508    0.08034  -0.935 0.350031
TreatmentModerate           0.44910    0.27163   1.653 0.098264 .
TreatmentHeavy              0.92501    0.27035   3.422 0.000623 ***
log(MaxTemp)                1.43257    0.10841  13.214  < 2e-16 ***
log(MinTemp)                0.49907    0.05385   9.268  < 2e-16 ***
qlogis(FPC)                 0.85368    0.04052  21.067  < 2e-16 ***
YearY2017:TreatmentModerate 0.46114    0.09466   4.871 1.11e-06 ***
YearY2018:TreatmentModerate -0.35187    0.09805  -3.589 0.000332 ***
YearY2019:TreatmentModerate 0.74905    0.09427   7.946 1.92e-15 ***
YearY2020:TreatmentModerate 0.17892    0.10265   1.743 0.081334 .
YearY2017:TreatmentHeavy    0.08896    0.08820   1.009 0.313139
YearY2018:TreatmentHeavy   -0.37241    0.09104  -4.090 4.31e-05 ***
YearY2019:TreatmentHeavy    0.51986    0.08930   5.822 5.82e-09 ***
YearY2020:TreatmentHeavy    0.73356    0.09252   7.929 2.21e-15 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Appendix I: Plant species list

I.1 Native plant species list

Species name	2015	2017	2018	2019
Acacia dealbata	x	x	x	x
Acaena novae-zelandiae	x	x	x	x
Alternanthera denticulata	x	x	x	x
Amphibromus fluitans	x	x		
Amphibromus nervosus	x	x	x	x
Amyema miquelii	x	x		
Amyema miraculosum	x			
Amyema pendula	x	x		
Arthropodium minus	x	x	x	x
Atriplex semibaccata	x	x	x	x
Austrostipa mollis				x
Austrostipa scabra	x		x	x
Azolla filiculoides	x	x	x	x
Azolla pinnata	x		x	x
Boerhavia dominii		x	x	
Brachyscome basaltica	x	x	x	x
Calotis scapigera	x	x	x	x
Cardamine moirensis	x	x		x
Cardamine paucijuga	x	x	x	x
Carex bichenoviana	x			
Carex inversa	x	x	x	x
Carex tereticaulis	x	x	x	x
Centella asiatica	x		x	x
Centella cordifolia	x	x	x	x
Centipeda cunninghamii	x	x	x	x
Centipeda minima	x	x	x	
Chamaesyce drummondii	x		x	
Chloris truncata		x	x	
Chrysocephalum apiculatum	x	x		
Cotula australis	x	x	x	x
Craspedia paludicola		x	x	x
Crassula colorata		x		
Crassula helmsii	x			x

Species name	2015	2017	2018	2019
Cycnogeton spp.	x	x	x	x
Cynodon dactylon	x	x	x	x
Cyperus exaltatus	x	x	x	
Cyperus gunnii		x		
Damasonium minus	x	x	x	x
Daucus glochidiatus	x	x	x	x
Deyeuxia quadriseta	x	x	x	x
Dianella longifolia	x	x	x	x
Dichelachne crinita		x		x
Dichondra repens	x	x	x	x
Dysphania pumilio	x	x	x	x
Echinochloa colona	x			
Eclipta platyglossa	x	x	x	x
Einadia nutans	x	x	x	x
Elatine gratioloides	x	x		
Eleocharis spp.	x	x	x	x
Elymus scaber	x		x	x
Enchylaena tomentosa	x		x	x
Enteropogon acicularis	x			
Epilobium billardiereanum	x	x	x	x
Epilobium hirtigerum	x	x	x	x
Eragrostis elongata	x			
Eryngium ovinum	x	x	x	x
Eucalyptus camaldulensis	x	x	x	x
Eucalyptus melliodora	x		x	x
Euchiton involucratus	x	x	x	x
Euchiton sphaericus	x	x	x	x
Eulalia aurea	x	x		
Euphorbia drummondii	x	x	x	x
Exocarpos strictus	x	x	x	x
Fimbristylis aestivalis		x		x
Glinus lotoides		x		
Glossostigma elatinoides		x	x	x
Goodenia geniculata	x			
Goodenia gracilis	x	x	x	x
Gratiola peruviana	x	x	x	x
Gratiola pumilo		x	x	

Species name	2015	2017	2018	2019
Haloragis heterophylla	x	x		x
Helichrysum bracteatum	x	x	x	
Hydrocotyle sibthorpioides	x	x	x	x
Hypericum gramineum	x	x	x	x
Isolepis hookeriana	x			
Juncus amabilis	x	x	x	x
Juncus aridicola	x	x	x	
Juncus australis	x			
Juncus flavidus	x	x	x	x
Juncus holoschoenus	x	x	x	x
Juncus ingens	x	x	x	x
Juncus procerus		x		
Juncus radula		x		x
Juncus remotiflorus	x			x
Juncus semisolidus			x	
Juncus sp. D1	x	x		
Juncus sp. H		x		
Juncus sp. I		x	x	
Juncus sp. M		x		
Juncus sp. Q	x	x	x	
Juncus sp. U		x		
Juncus subglaucus	x	x		
Juncus subsecundus	x	x	x	x
Lachnagrostis filiformis	x	x	x	x
Lemna disperma			x	
Lepidium pseudohyssopifolium		x	x	
Linum marginale	x	x	x	x
Ludwigia peploides	x	x	x	x
Lythrum hyssopifolia	x	x	x	x
Maireana enchylaenoides		x		x
Marsilea angustifolia		x		
Marsilea costulifera	x	x	x	x
Marsilea drummondii	x	x	x	x
Mentha australis		x		x
Mentha diemenica	x		x	x
Mentha laxiflora	x			
Mentha satureioides	x		x	x

Species name	2015	2017	2018	2019
Myriophyllum spp.	x	x	x	x
Nymphoides crenata	x	x	x	x
Ottelia ovalifolia	x			
Oxalis perennans	x	x	x	x
Paspalidium jubiflorum	x	x	x	x
Paspalum distichum	x	x		
Persicaria decipiens	x	x	x	x
Persicaria hydropiper	x	x	x	x
Persicaria prostrata	x	x	x	x
Phragmites australis	x	x	x	x
Plantago cunninghamii	x			
Plantago gaudichaudii		x	x	
Poa labillardierei	x	x	x	x
Pogonolepis muelleriana				x
Potamogeton cheesemanii	x	x	x	x
Pratia concolor	x	x	x	x
Pratia pedunculata	x			
Pseudognaphalium luteoalbum	x	x	x	x
Pseudoraphis spinescens	x	x	x	x
Ranunculus inundatus	x	x	x	x
Ranunculus lappaceus		x	x	x
Ranunculus pumilio		x	x	x
Rhodanthe corymbiflora		x	x	x
Rorippa laciniata		x		
Rumex brownii	x	x	x	x
Rumex tenax		x	x	x
Rytidosperma bipartitum		x		
Rytidosperma caespitosum	x		x	x
Rytidosperma duttonianum	x	x		
Rytidosperma erianthum			x	x
Rytidosperma fulvum	x	x	x	
Rytidosperma setaceum	x	x	x	x
Sclerolaena muricata	x			
Senecio bathurstianus				x
Senecio campylocarpus	x	x	x	x
Senecio quadridentatus	x	x	x	x
Senecio runcinifolius	x	x	x	x

Species name	2015	2017	2018	2019
Sigesbeckia orientalis	x	x	x	x
Solenogyne dominii	x	x	x	x
Spergularia brevifolia		x	x	x
Stellaria angustifolia	x	x	x	x
Stellaria caespitosa		x		
Stellaria pungens	x	x		
Stellaria spaff-angustifolia		x		
Typha australis			x	
Typha domingensis	x	x	x	
Typha orientalis	x			
Verbena gaudichaudii	x	x	x	
Vicia disperma				x
Viola betonicifolia	x			
Vittadinia cuneata	x	x	x	x
Vittadinia gracilis	x	x	x	x
Vulpia bromoides	x	x		x
Wahlenbergia spp.	x	x	x	x
Walwhalleya proluta			x	
Xerochrysum bracteatum	x	x	x	x
Xerochrysum viscosum	x			x

I.2 Exotic plant species list

Species name	2015	2017	2018	2019
Aira cupaniana	x		x	
Aira elegantissima		x		x
Anagallis arvensis	x	x	x	x
Anthoxanthum odoratum	x	x		
Arctotheca calendula	x	x		
Aster subulatus	x	x	x	x
Avena barbata	x	x	x	x
Avena fatua	x	x		x
Avena sativa				x
Briza minor	x	x		
Bromus diandrus	x	x	x	
Bromus hordeaceus	x	x	x	x
Bromus molliformis	x			x

Species name	2015	2017	2018	2019
Bromus rubens		x		x
Callitriche stagnalis		x		
Capsella bursa-pastoris		x	x	x
Carduus tenuiflorus	x	x		x
Centaurea melitensis	x	x	x	x
Centaurium tenuiflorum	x	x	x	x
Chenopodium album	x			x
Chondrilla juncea			x	x
Cirsium vulgare	x	x	x	x
Conyza spp.	x	x	x	x
Cucumis myriocarpus	x			x
Cyperus eragrostis	x	x		x
Dittrichia graveolens		x	x	
Echinochloa crus-galli	x			
Echium plantagineum	x	x	x	x
Echium vulgare	x			x
Ehrharta erecta	x	x	x	x
Ehrharta longiflora	x	x	x	
Euphorbia peplus		x	x	x
Fumaria muralis	x	x	x	x
Fumaria officinalis	x			
Galium aparine	x	x	x	x
Gnaphalium polycaulon		x		
Hedypnois rhagadioloides	x	x		
Heliotropium europaeum	x	x		
Helminthotheca echioides	x	x	x	x
Hordeum glaucum		x	x	x
Hypericum perforatum	x		x	x
Hypochaeris glabra	x	x	x	x
Hypochaeris radicata	x	x	x	x
Kickxia elatine				x
Lactuca saligna	x	x	x	x
Lactuca serriola	x	x	x	x
Leontodon taraxacoides	x	x	x	
Lepidium africanum				x
Lolium loliaceum	x		x	x
Lolium perenne	x	x		x

Species name	2015	2017	2018	2019
Lolium rigidum	x	x	x	x
Lotus subbiflorus	x			
Ludwigia palustris	x	x	x	x
Marrubium vulgare	x	x	x	x
Medicago polymorpha		x	x	x
Mentha pulegium	x	x	x	x
Modiola caroliniana		x		x
Panicum capillare			x	
Petrorhagia dubia	x	x	x	x
Phalaris paradoxa	x	x	x	x
Phyla canescens		x	x	x
Phyla nodiflora			x	
Plantago coronopus	x	x		x
Polycarpon tetraphyllum	x			
Polygonum arenastrum	x			
Polygonum aviculare	x	x	x	x
Rorippa nasturtium-aquaticum	x			
Rorippa palustris		x	x	
Rostraria cristata	x			
Rubus fruticosus		x	x	x
Sagittaria platyphylla	x	x	x	x
Scorzonera laciniata		x		
Sisymbrium irio		x		x
Solanum nigrum	x	x	x	x
Sonchus asper	x	x	x	x
Sonchus oleraceus	x	x	x	x
Spergularia diandra	x			
Stellaria media	x	x	x	x
Stellaria pallida				x
Taraxacum officinale	x	x	x	
Trifolium angustifolium		x	x	
Trifolium arvense	x	x	x	x
Trifolium campestre	x	x	x	x
Trifolium cernuum	x	x	x	
Trifolium dubium		x		
Trifolium globosum			x	
Trifolium glomeratum	x	x	x	x

Species name	2015	2017	2018	2019
Trifolium hirtum	x		x	x
Trifolium subterraneum		x		
Trifolium tomentosum		x		
Urtica urens		x		x
Verbascum virgatum	x	x	x	x
Verbena bonariensis	x	x	x	x
Verbena officinalis		x	x	x
Veronica peregrina		x		
Vicia hirsuta	x		x	
Vicia sativa		x		x
Vulpia muralis	x	x	x	
Vulpia myuros	x	x	x	
Xanthium spinosum	x	x	x	x

Appendix J: Bird species list

Species name	2015	2017	2018	2019
Australian hobby	x			x
Australian magpie	x	x	x	x
Australian raven	x	x	x	x
Australian reed warbler	x	x		x
Australian shelduck	x			
Australian white ibis	x	x		
Australian wood duck		x		
Azure kingfisher		x		
Black-chinned honeyeater	x			x
Black-faced cuckoo-shrike	x	x	x	x
Blue-faced honeyeater	x	x		x
Brahminy kite			x	
Brown-headed honeyeater	x	x	x	x
Brown falcon		x		
Brown goshawk	x	x	x	x
Brown songlark				x
Brown thornbill	x	x	x	x
Brown treecreeper	x	x	x	x
Buff-rumped thornbill	x	x	x	x
Collared sparrowhawk		x		
Common bronzewing	x	x	x	x
Crested shrike-tit	x	x	x	x
Crimson rosella			x	
Dollarbird	x	x	x	x
Dusky woodswallow	x	x	x	x
Eastern great egret	x			
Eastern rosella	x	x	x	x
Emu	x	x	x	
Fan-tailed cuckoo	x	x		x
Fork-tailed swift			x	
Galah	x	x	x	x
Golden whistler	x	x		x
Great egret	x			
Grey-crowned babbler		x		
Grey butcherbird			x	

Species name	2015	2017	2018	2019
Grey fantail	x	x	x	x
Grey shrike-thrush	x	x	x	x
Grey teal	x			x
Hooded robin	x	x		x
Horsfields bronze-cuckoo	x	x	x	x
Intermediate egret	x			
Jacky winter	x	x	x	x
Laughing kookaburra	x	x	x	x
Leaden flycatcher	x	x		x
Little eagle	x	x		
Little friarbird	x	x	x	x
Little grassbird	x	x		
Little raven	x	x	x	x
Long-billed corella	x	x	x	x
Magpie-lark	x	x		
Mistletoebird	x	x	x	x
Nankeen night heron	x		x	
Noisy friarbird	x	x	x	x
Olive-backed oriole	x			x
Pacific black duck	x	x	x	x
Painted button-quail	x	x		
Painted honeyeater			x	x
Pallid cuckoo		x	x	
Peaceful dove	x	x	x	x
Peregrine falcon	x	x	x	x
Pied butcherbird	x	x		x
Rainbow bee-eater	x	x	x	x
Red-capped robin	x	x	x	x
Red-rumped parrot	x	x	x	x
Red wattlebird	x			
Restless flycatcher	x	x		
Royal spoonbill	x			
Rufous fantail		x		
Rufous songlark	x	x		x
Rufous whistler	x	x	x	x
Sacred kingfisher	x	x	x	x
Satin flycatcher		x		

Species name	2015	2017	2018	2019
Scarlet robin	x	x	x	x
Shining bronze-cuckoo	x	x	x	
Silvereye	x	x	x	x
Southern boobook	x			
Spotted pardalote	x	x	x	x
Striated pardalote	x	x	x	x
Striated thornbill	x	x	x	x
Sulphur-crested cockatoo	x	x	x	x
Superb fairy-wren	x	x	x	x
Superb parrot	x	x	x	x
Swamp harrier				x
Tree martin	x	x	x	
Varied sittella	x	x	x	x
Wedge-tailed eagle	x	x	x	x
Weebill	x	x	x	x
Welcome swallow	x	x	x	
Western gerygone	x	x	x	x
Whistling kite	x	x	x	x
White-bellied sea-eagle	x		x	x
White-breasted woodswallow	x	x	x	x
White-browed babbler	x	x	x	x
White-browed scrubwren	x	x	x	x
White-browed woodswallow			x	x
White-faced heron	x	x	x	x
White-necked heron	x	x		x
White-plumed honeyeater	x	x	x	x
White-throated treecreeper	x	x	x	x
White-winged chough	x	x	x	x
White-winged triller	x	x	x	x
Willie wagtail	x	x	x	x
Yellow-rumped thornbill	x	x	x	x
Yellow rosella	x	x	x	x
Yellow thornbill	x	x	x	x