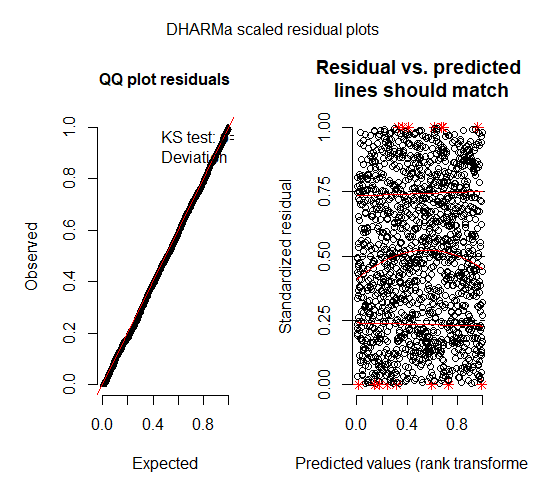
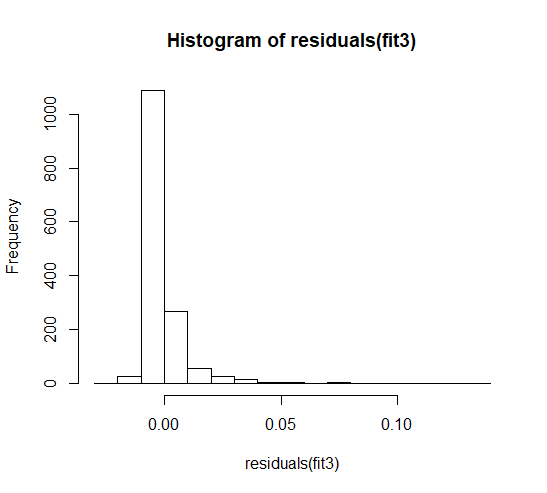
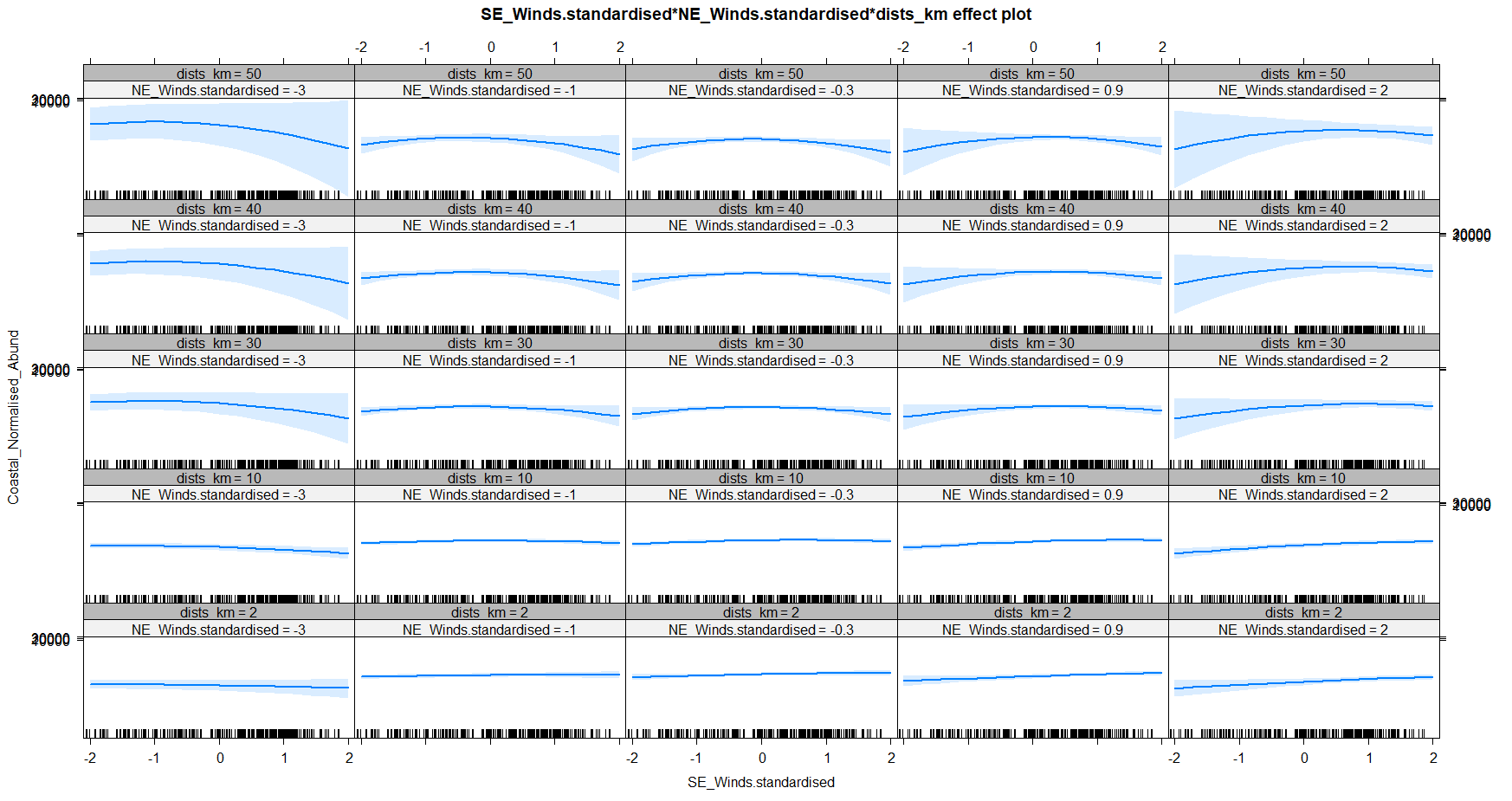
**Model outputs**

**Larval fish and wind mechanism (14 day prior winds)**

Model assumptions = good





Summary:

|  |
| --- |
| > summary(fit4)  Family: tweedie ( log )  Formula: Coastal\_Normalised\_Abund ~ poly(NE\_Winds.standardised, degree = 2) \*  dists\_km + poly(SE\_Winds.standardised, degree = 2) \* dists\_km +  SE\_Winds.standardised:NE\_Winds.standardised \* dists\_km + (1 | Project\_ID)  Data: fish\_data  AIC BIC logLik deviance df.resid  -6281.2 -6201.6 3155.6 -6311.2 1474  Random effects:  Conditional model:  Groups Name Variance Std.Dev.  Project\_ID (Intercept) 0.7931 0.8906  Number of obs: 1489, groups: Project\_ID, 7  Overdispersion parameter for tweedie family (): 0.313  Conditional model:  Estimate Std. Error z value Pr(>|z|)  (Intercept) -5.864301 0.410045 -14.302 < 2e-16 \*\*\*  poly(NE\_Winds.standardised, degree = 2)1 -7.574829 6.127471 -1.236 0.216381  poly(NE\_Winds.standardised, degree = 2)2 -28.865104 6.251461 -4.617 3.89e-06 \*\*\*  dists\_km -0.025840 0.018922 -1.366 0.172066  poly(SE\_Winds.standardised, degree = 2)1 23.043052 6.591032 3.496 0.000472 \*\*\*  poly(SE\_Winds.standardised, degree = 2)2 -1.147363 6.499549 -0.177 0.859878  poly(NE\_Winds.standardised, degree = 2)1:dists\_km 0.225964 0.526775 0.429 0.667954  poly(NE\_Winds.standardised, degree = 2)2:dists\_km 1.226346 0.549981 2.230 0.025761 \*  dists\_km:poly(SE\_Winds.standardised, degree = 2)1 -0.275417 0.596321 -0.462 0.644182  dists\_km:poly(SE\_Winds.standardised, degree = 2)2 -0.935062 0.664595 -1.407 0.159438  SE\_Winds.standardised:NE\_Winds.standardised 0.308364 0.238769 1.291 0.196540  dists\_km:SE\_Winds.standardised:NE\_Winds.standardised 0.009519 0.023077 0.413 0.679967  ---  Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1 |

Anova(fit4,type="II",test="Chisq")

Analysis of Deviance Table (Type II Wald chisquare tests)

Response: Coastal\_Normalised\_Abund

Chisq Df Pr(>Chisq)

poly(NE\_Winds.standardised, degree = 2) 43.5165 2 3.552e-10 \*\*\*

dists\_km 11.1569 1 0.0008372 \*\*\*

poly(SE\_Winds.standardised, degree = 2) 31.8911 2 1.188e-07 \*\*\*

poly(NE\_Winds.standardised, degree = 2):dists\_km 5.0973 2 0.0781888 .

dists\_km:poly(SE\_Winds.standardised, degree = 2) 4.5317 2 0.1037403

SE\_Winds.standardised:NE\_Winds.standardised 13.3026 1 0.0002650 \*\*\*

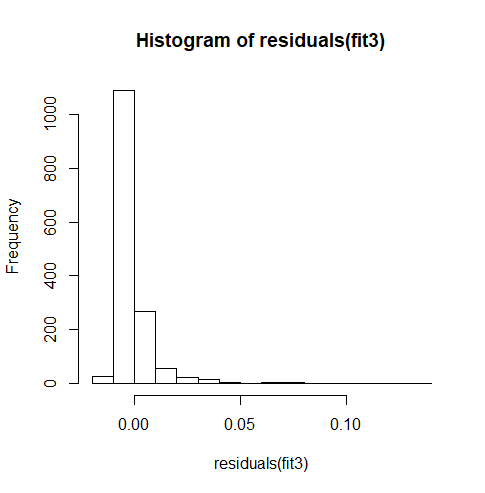
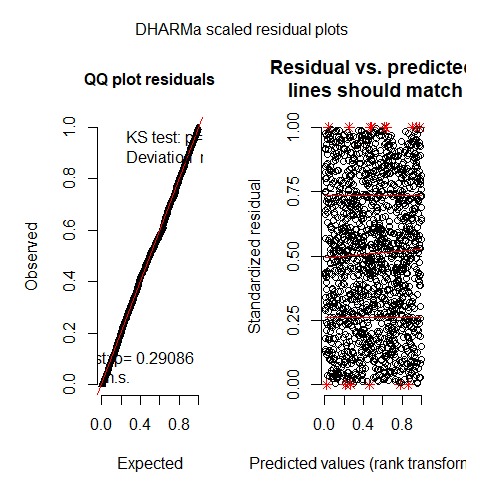
dists\_km:SE\_Winds.standardised:NE\_Winds.standardised 0.1702 1 0.6799674

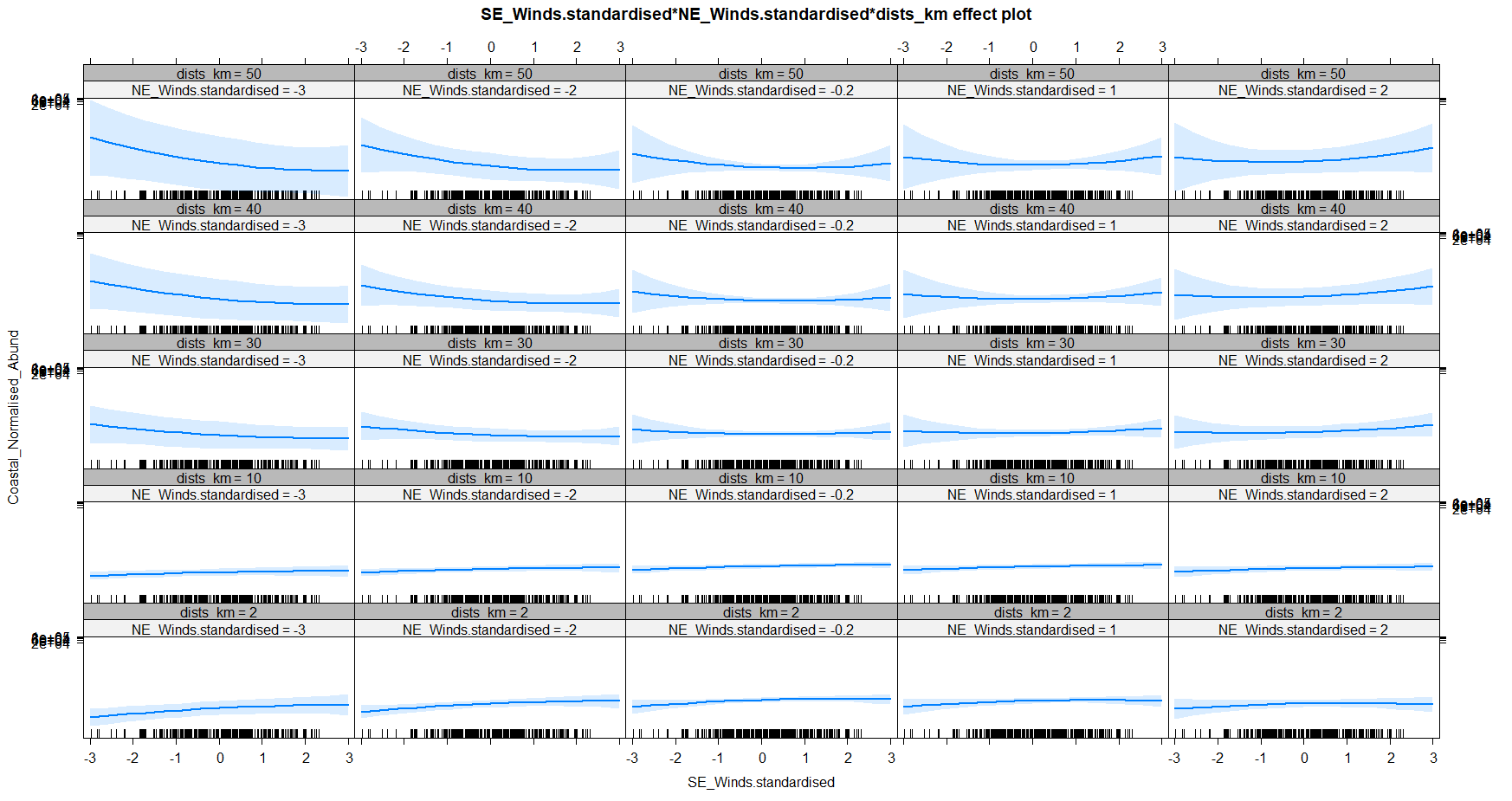
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

**Larval fish and wind mechanism (3 day prior winds)**

Model assumptions = good





Summary:

> summary(fit3)

Family: tweedie ( log )

Formula: Coastal\_Normalised\_Abund ~ poly(cbind(SE\_Winds.standardised,

NE\_Winds.standardised), degree = 2) \* dists\_km + (1 | Project\_ID)

Data: fish\_data

AIC BIC logLik deviance df.resid

-6250.0 -6170.4 3140.0 -6280.0 1474

Random effects:

Conditional model:

Groups Name Variance Std.Dev.

Project\_ID (Intercept) 0.599 0.774

Number of obs: 1489, groups: Project\_ID, 7

Overdispersion parameter for tweedie family (): 0.33

Conditional model:

Estimate Std. Error z value Pr(>|z|)

(Intercept) -5.617e+00 3.322e-01 -16.910 < 2e-16 \*\*\*

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)1.0 1.491e+01 5.485e+00 2.718 0.00656 \*\*

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)2.0 -5.793e+00 5.657e+00 -1.024 0.30579

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)0.1 1.342e+00 4.856e+00 0.276 0.78226

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)1.1 -1.400e+02 1.918e+02 -0.730 0.46550

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)0.2 -1.542e+01 6.620e+00 -2.329 0.01988 \*

dists\_km -1.592e-02 9.174e-03 -1.736 0.08261 .

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)1.0:dists\_km -6.265e-01 5.115e-01 -1.225 0.22060

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)2.0:dists\_km 4.078e-01 4.751e-01 0.858 0.39078

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)0.1:dists\_km 1.805e-01 4.301e-01 0.420 0.67471

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)1.1:dists\_km 1.403e+01 1.395e+01 1.006 0.31460

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)0.2:dists\_km 5.743e-01 5.569e-01 1.031 0.30239

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

ANOVA:

> Anova(fit3,type="II",test="Chisq")

Analysis of Deviance Table (Type II Wald chisquare tests)

Response: Coastal\_Normalised\_Abund

Chisq Df Pr(>Chisq)

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2) 67.2333 5 3.854e-13 \*\*\*

dists\_km 17.2157 1 3.337e-05 \*\*\*

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2):dists\_km 6.2845 5 0.2795

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

> Anova(fit4,type="II",test="Chisq")

Analysis of Deviance Table (Type II Wald chisquare tests)

Response: Coastal\_Normalised\_Abund

Chisq Df Pr(>Chisq)

poly(NE\_Winds.standardised, degree = 2) 18.3925 2 0.0001014 \*\*\*

dists\_km 17.2164 1 3.335e-05 \*\*\*

poly(SE\_Winds.standardised, degree = 2) 14.0576 2 0.0008860 \*\*\*

poly(NE\_Winds.standardised, degree = 2):dists\_km 1.6351 2 0.4415011

dists\_km:poly(SE\_Winds.standardised, degree = 2) 1.5009 2 0.4721459

SE\_Winds.standardised:NE\_Winds.standardised 0.2136 1 0.6439485

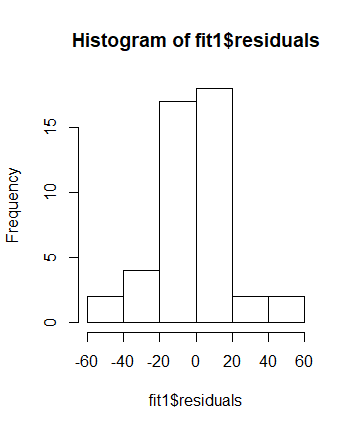
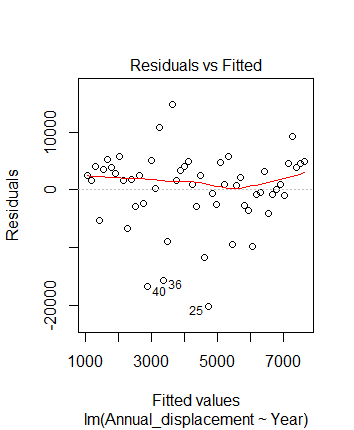
dists\_km:SE\_Winds.standardised:NE\_Winds.standardised 1.0120 1 0.3144258

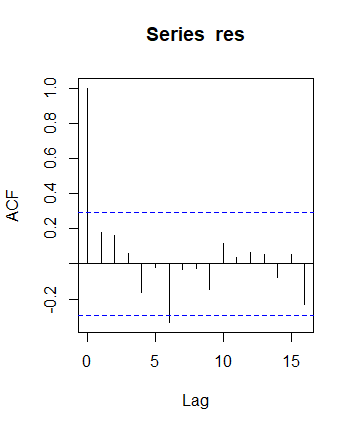
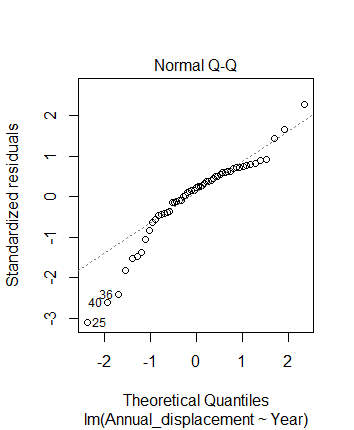
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

**SE Historical Wind Changes Model – Every 3rd year**

Model assumptions (OK, not perfect) – **Some Autocorrelation!**?!?!





Summary:

> summary(fit1) # -0.161 decline per year (p = 0.02)

Call:

lm(formula = sqrt(Annual\_displacement) ~ Year, data = dat2\_2)

Residuals:

Min 1Q Median 3Q Max

-52.175 -11.675 -0.525 14.771 59.579

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 391.09657 129.15046 3.028 0.00415 \*\*

Year -0.16144 0.06695 -2.411 0.02024 \*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 22.15 on 43 degrees of freedom

(10 observations deleted due to missingness)

Multiple R-squared: 0.1191, Adjusted R-squared: 0.09862

F-statistic: 5.814 on 1 and 43 DF, p-value: 0.02024

ANOVA:

> anova(fit1)

Analysis of Variance Table

Response: sqrt(Annual\_displacement)

Df Sum Sq Mean Sq F value Pr(>F)

Year 1 2851.3 2851.35 5.8141 0.02024 \*

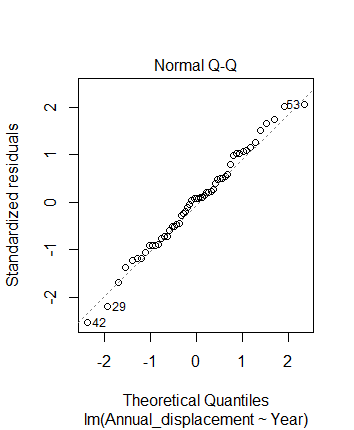
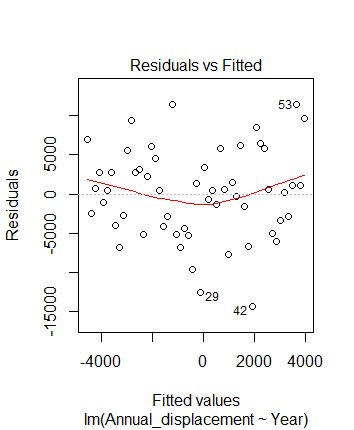
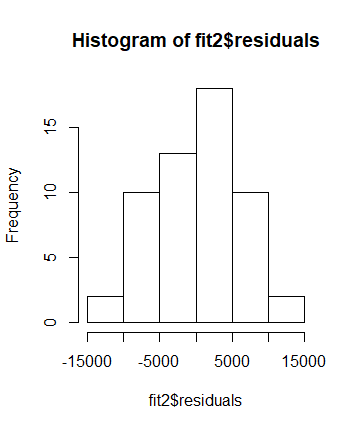
Residuals 43 21088.1 490.42

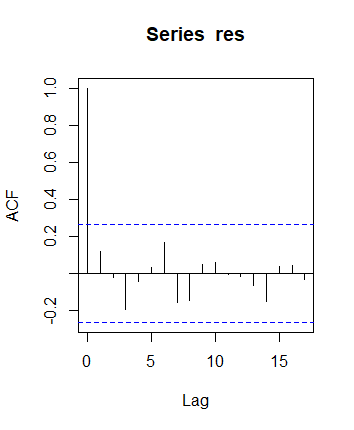
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

NE Historical Winds

Assumptions (OK)





Summary:

> summary(fit2) # increase by 52.64 per year (p = 0.002)

Call:

lm(formula = Annual\_displacement ~ Year, data = dat\_NE2)

Residuals:

Min 1Q Median 3Q Max

-14393.6 -4117.9 416.6 3224.9 11488.5

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -101972.87 31560.29 -3.231 0.00212 \*\*

Year 52.64 16.33 3.223 0.00217 \*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 5768 on 53 degrees of freedom

Multiple R-squared: 0.1639, Adjusted R-squared: 0.1481

F-statistic: 10.39 on 1 and 53 DF, p-value: 0.002169

ANOVA:

> anova(fit2)

Analysis of Variance Table

Response: Annual\_displacement

Df Sum Sq Mean Sq F value Pr(>F)

Year 1 345654429 345654429 10.39 0.002169 \*\*

Residuals 53 1763134462 33266688

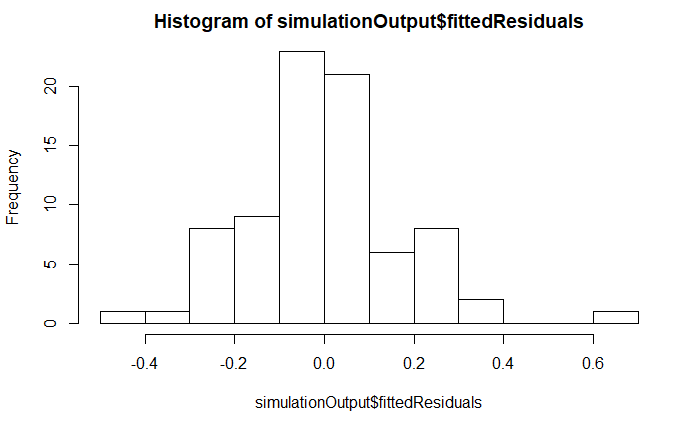
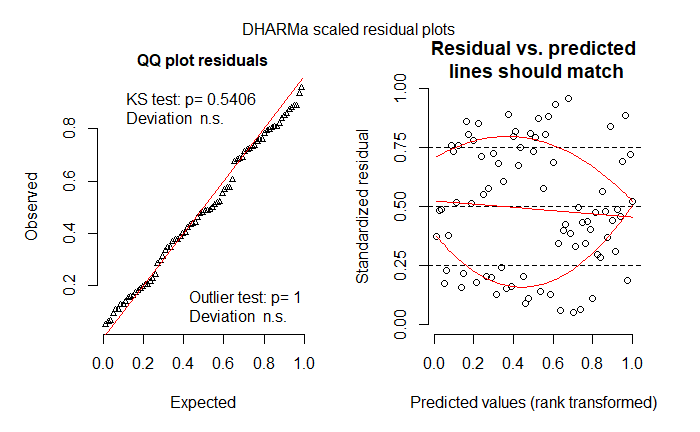
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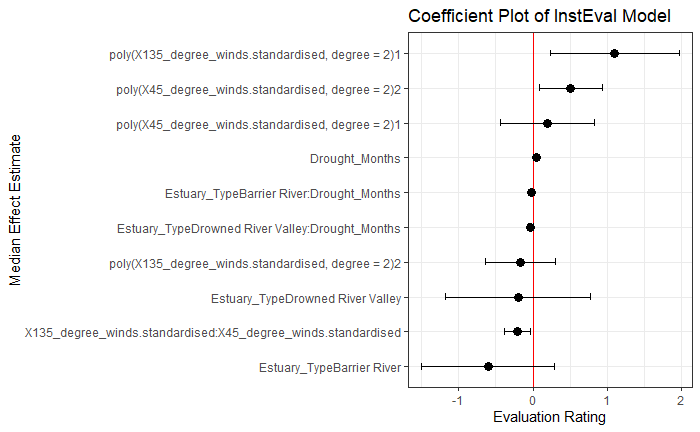
Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Commercial Scale:

**Bream** (r2m = 0.266, r2c = 0.913):

Assumptions (Good):





Summary:

Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']

Formula: log10(CPUE) ~ poly(X135\_degree\_winds.standardised, degree = 2) +

poly(X45\_degree\_winds.standardised, degree = 2) + X135\_degree\_winds.standardised:X45\_degree\_winds.standardised +

Estuary\_Type \* Drought\_Months + (1 | Estuary)

Data: bream

REML criterion at convergence: 17.2

Scaled residuals:

Min 1Q Median 3Q Max

-2.14519 -0.46137 -0.04973 0.39382 3.14530

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 0.27767 0.5269

Residual 0.03732 0.1932

Number of obs: 80, groups: Estuary, 8

Fixed effects:

Estimate Std. Error df t value Pr(>|t|)

(Intercept) 1.59700 0.30973 5.21938 5.156 0.003176 \*\*

poly(X135\_degree\_winds.standardised, degree = 2)1 1.13183 0.43501 65.47370 2.602 0.011454 \*

poly(X135\_degree\_winds.standardised, degree = 2)2 -0.16991 0.23547 64.31357 -0.722 0.473173

poly(X45\_degree\_winds.standardised, degree = 2)1 0.17446 0.32317 65.34730 0.540 0.591150

poly(X45\_degree\_winds.standardised, degree = 2)2 0.51562 0.21598 64.24288 2.387 0.019920 \*

Estuary\_TypeBarrier River -0.60393 0.43589 5.11890 -1.385 0.223235

Estuary\_TypeDrowned River Valley -0.19476 0.48754 5.12704 -0.399 0.705636

Drought\_Months 0.04348 0.01126 64.11992 3.860 0.000266 \*\*\*

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised -0.21669 0.09181 64.27768 -2.360 0.021316 \*

Estuary\_TypeBarrier River:Drought\_Months -0.02096 0.01458 64.06577 -1.438 0.155431

Estuary\_TypeDrowned River Valley:Drought\_Months -0.02915 0.01708 64.05569 -1.707 0.092708 .

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:

(Intr) p(X135\_\_.,d=2)1 p(X135\_\_.,d=2)2 p(X45\_\_.,d=2)1 p(X45\_\_.,d=2)2 Es\_TBR Es\_TDRV Drgh\_M X135\_\_ E\_TBR:

p(X135\_\_.,d=2)1 0.077

p(X135\_\_.,d=2)2 -0.043 -0.369

p(X45\_\_.,d=2)1 0.036 0.496 -0.248

p(X45\_\_.,d=2)2 -0.008 -0.057 0.082 -0.120

Estry\_TypBR -0.705 -0.015 -0.014 -0.018 0.001

Estry\_TyDRV -0.630 0.000 0.020 0.012 -0.013 0.447

Drght\_Mnths -0.128 -0.151 0.109 0.069 -0.116 0.078 0.076

X135\_\_.:X45 -0.091 -0.746 0.406 -0.522 0.219 0.016 -0.004 0.124

Est\_TBR:D\_M 0.092 0.035 0.012 -0.001 0.126 -0.108 -0.055 -0.743 -0.053

Es\_TDRV:D\_M 0.074 0.004 0.005 -0.031 0.086 -0.052 -0.113 -0.627 0.012 0.484

Anova:

Type III Analysis of Variance Table with Satterthwaite's method

Sum Sq Mean Sq NumDF DenDF F value Pr(>F)

poly(X135\_degree\_winds.standardised, degree = 2) 0.25512 0.12756 2 64.808 3.4177 0.0388062 \*

poly(X45\_degree\_winds.standardised, degree = 2) 0.23856 0.11928 2 64.800 3.1958 0.0474605 \*

Estuary\_Type 0.07389 0.03695 2 5.126 0.9899 0.4330008

Drought\_Months 0.55895 0.55895 1 64.217 14.9754 0.0002573 \*\*\*

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised 0.20790 0.20790 1 64.278 5.5702 0.0213155 \*

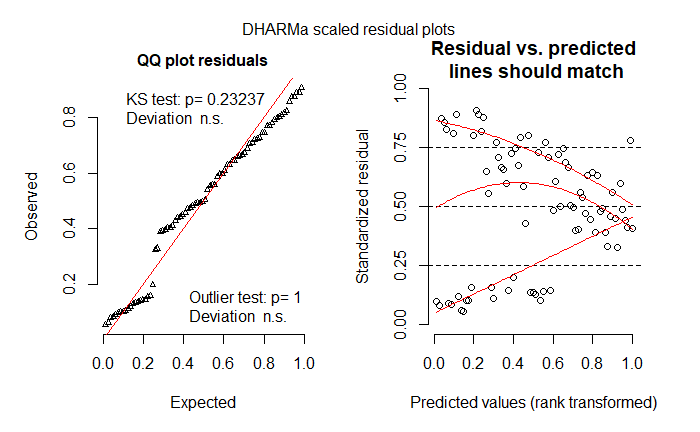
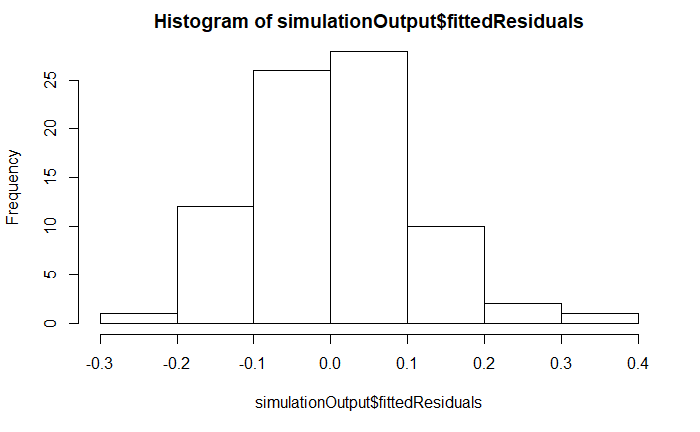
Estuary\_Type:Drought\_Months 0.12697 0.06348 2 64.063 1.7009 0.1906657

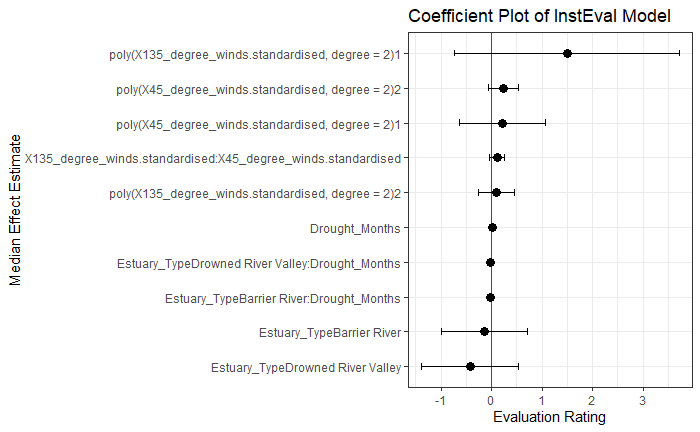
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Mullet (r2m = 0.148, r2c = 0.964):

Assumptions (OK):





Summary:

Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']

Formula: log10(CPUE) ~ poly(X135\_degree\_winds.standardised, degree = 2) +

poly(X45\_degree\_winds.standardised, degree = 2) + X135\_degree\_winds.standardised:X45\_degree\_winds.standardised +

Estuary\_Type \* Drought\_Months + (1 | Estuary)

Data: mullet

REML criterion at convergence: -48.7

Scaled residuals:

Min 1Q Median 3Q Max

-2.1661 -0.6572 0.0086 0.5269 3.3444

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 0.28755 0.5362

Residual 0.01364 0.1168

Number of obs: 80, groups: Estuary, 8

Fixed effects:

Estimate Std. Error df t value Pr(>|t|)

(Intercept) 2.085189 0.372849 10.167878 5.593 0.000216 \*\*\*

poly(X135\_degree\_winds.standardised, degree = 2)1 1.468579 1.108698 64.287648 1.325 0.189994

poly(X135\_degree\_winds.standardised, degree = 2)2 0.102986 0.179624 64.192261 0.573 0.568418

poly(X45\_degree\_winds.standardised, degree = 2)1 0.212869 0.419256 64.066807 0.508 0.613386

poly(X45\_degree\_winds.standardised, degree = 2)2 0.242085 0.153779 64.091642 1.574 0.120356

Estuary\_TypeBarrier River -0.131080 0.440394 5.027521 -0.298 0.777883

Estuary\_TypeDrowned River Valley -0.433555 0.492381 5.027789 -0.881 0.418667

Drought\_Months 0.020741 0.007248 64.097065 2.862 0.005687 \*\*

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised 0.114796 0.073931 64.157501 1.553 0.125403

Estuary\_TypeBarrier River:Drought\_Months -0.027801 0.008983 64.011451 -3.095 0.002920 \*\*

Estuary\_TypeDrowned River Valley:Drought\_Months -0.026118 0.010495 64.003119 -2.489 0.015432 \*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

ANOVA:

Type III Analysis of Variance Table with Satterthwaite's method

Sum Sq Mean Sq NumDF DenDF F value Pr(>F)

poly(X135\_degree\_winds.standardised, degree = 2) 0.025495 0.012748 2 64.213 0.9343 0.398133

poly(X45\_degree\_winds.standardised, degree = 2) 0.034003 0.017002 2 64.090 1.2461 0.294501

Estuary\_Type 0.010737 0.005369 2 5.026 0.3935 0.693813

Drought\_Months 0.005353 0.005353 1 64.158 0.3924 0.533281

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised 0.032896 0.032896 1 64.158 2.4110 0.125403

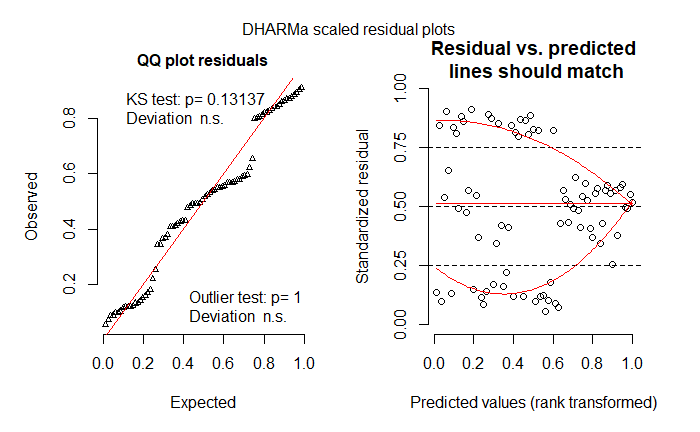
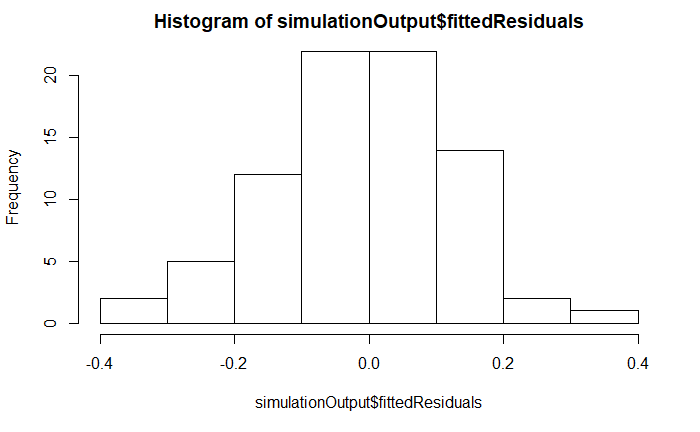
Estuary\_Type:Drought\_Months 0.148349 0.074174 2 64.006 5.4364 0.006597 \*\*

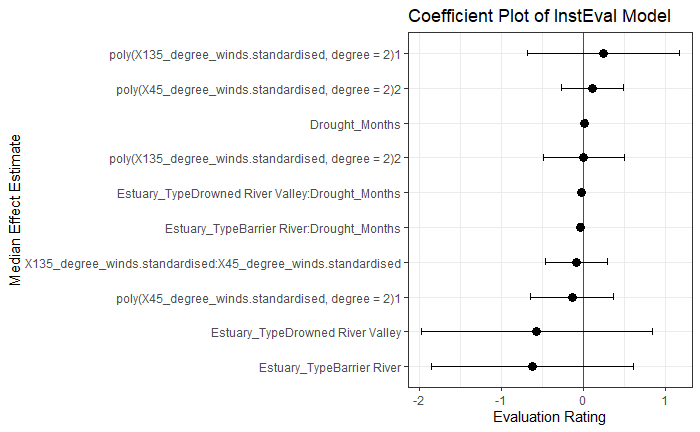
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Luderick (r2m = 0.152, r2c = 0.969):

Assumptions (OK)





Summary:

Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']

Formula: log10(CPUE) ~ poly(X135\_degree\_winds.standardised, degree = 2) +

poly(X45\_degree\_winds.standardised, degree = 2) + X135\_degree\_winds.standardised:X45\_degree\_winds.standardised +

Estuary\_Type \* Drought\_Months + (1 | Estuary)

Data: luderick

REML criterion at convergence: -13.4

Scaled residuals:

Min 1Q Median 3Q Max

-2.51100 -0.61027 -0.03172 0.60494 2.38146

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 0.58974 0.7679

Residual 0.02268 0.1506

Number of obs: 80, groups: Estuary, 8

Fixed effects:

Estimate Std. Error df t value Pr(>|t|)

(Intercept) 1.849356 0.445152 5.032210 4.154 0.00875 \*\*

poly(X135\_degree\_winds.standardised, degree = 2)1 0.234143 0.456338 65.028764 0.513 0.60963

poly(X135\_degree\_winds.standardised, degree = 2)2 0.006426 0.245266 64.441841 0.026 0.97918

poly(X45\_degree\_winds.standardised, degree = 2)1 -0.124870 0.245318 64.879135 -0.509 0.61247

poly(X45\_degree\_winds.standardised, degree = 2)2 0.122144 0.189879 64.082363 0.643 0.52234

Estuary\_TypeBarrier River -0.609405 0.629343 5.025927 -0.968 0.37714

Estuary\_TypeDrowned River Valley -0.510996 0.703741 5.029165 -0.726 0.50014

Drought\_Months 0.020384 0.008724 64.058566 2.336 0.02261 \*

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised -0.076516 0.185853 64.202181 -0.412 0.68193

Estuary\_TypeBarrier River:Drought\_Months -0.032808 0.011418 64.022906 -2.873 0.00551 \*\*

Estuary\_TypeDrowned River Valley:Drought\_Months -0.021376 0.013267 64.021592 -1.611 0.11204

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

ANOVA:

Type III Analysis of Variance Table with Satterthwaite's method

Sum Sq Mean Sq NumDF DenDF F value Pr(>F)

poly(X135\_degree\_winds.standardised, degree = 2) 0.010373 0.005187 2 64.546 0.2286 0.79625

poly(X45\_degree\_winds.standardised, degree = 2) 0.017029 0.008514 2 64.468 0.3753 0.68854

Estuary\_Type 0.023705 0.011852 2 5.027 0.5225 0.62207

Drought\_Months 0.004178 0.004178 1 64.112 0.1842 0.66925

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised 0.003845 0.003845 1 64.202 0.1695 0.68193

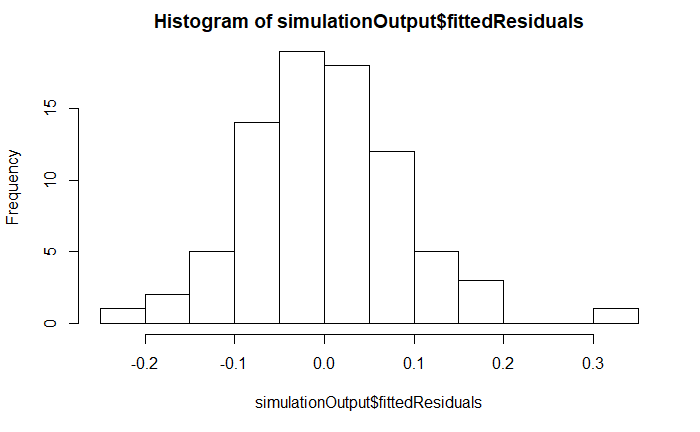
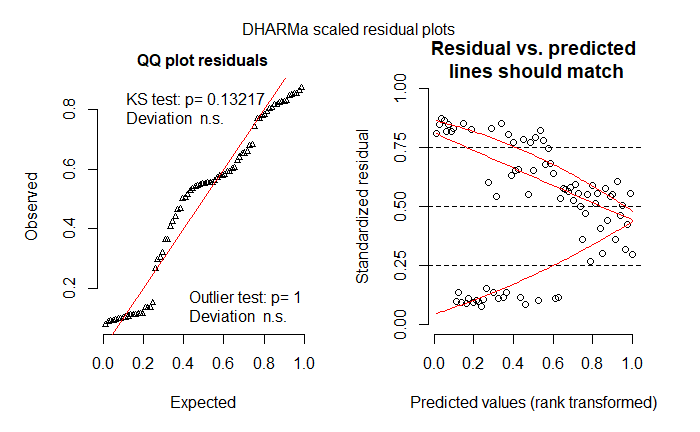
Estuary\_Type:Drought\_Months 0.189265 0.094632 2 64.022 4.1717 0.01981 \*

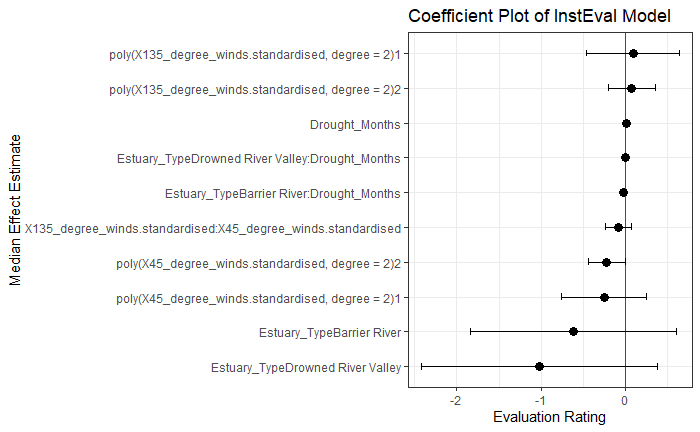
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Flathead (r2m = 0.152, r2c = 0.969):

Assumptions (OK):





Summary:

Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']

Formula: log10(CPUE) ~ poly(X135\_degree\_winds.standardised, degree = 2) +

poly(X45\_degree\_winds.standardised, degree = 2) + X135\_degree\_winds.standardised:X45\_degree\_winds.standardised +

Estuary\_Type \* Drought\_Months + (1 | Estuary)

Data: flathead

REML criterion at convergence: -66.8

Scaled residuals:

Min 1Q Median 3Q Max

-2.0582 -0.5673 -0.0217 0.5088 3.2745

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 0.549699 0.74142

Residual 0.009827 0.09913

Number of obs: 80, groups: Estuary, 8

Fixed effects:

Estimate Std. Error df t value Pr(>|t|)

(Intercept) 1.853740 0.429460 5.042476 4.316 0.00745 \*\*

poly(X135\_degree\_winds.standardised, degree = 2)1 0.106948 0.279685 64.686798 0.382 0.70343

poly(X135\_degree\_winds.standardised, degree = 2)2 0.069535 0.144683 64.126753 0.481 0.63243

poly(X45\_degree\_winds.standardised, degree = 2)1 -0.239777 0.254951 64.453114 -0.940 0.35048

poly(X45\_degree\_winds.standardised, degree = 2)2 -0.233080 0.117920 64.045468 -1.977 0.05240 .

Estuary\_TypeBarrier River -0.605910 0.606494 5.014259 -0.999 0.36352

Estuary\_TypeDrowned River Valley -1.041402 0.678070 5.013952 -1.536 0.18502

Drought\_Months 0.007526 0.006011 64.040220 1.252 0.21507

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised -0.089960 0.077593 64.122483 -1.159 0.25060

Estuary\_TypeBarrier River:Drought\_Months -0.027681 0.007467 64.014835 -3.707 0.00044 \*\*\*

Estuary\_TypeDrowned River Valley:Drought\_Months 0.002437 0.008800 64.014090 0.277 0.78271

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

ANOVA:

Type III Analysis of Variance Table with Satterthwaite's method

Sum Sq Mean Sq NumDF DenDF F value Pr(>F)

poly(X135\_degree\_winds.standardised, degree = 2) 0.006092 0.003046 2 64.387 0.3099 0.7345791

poly(X45\_degree\_winds.standardised, degree = 2) 0.052286 0.026143 2 64.250 2.6603 0.0776256 .

Estuary\_Type 0.024377 0.012189 2 5.014 1.2403 0.3650551

Drought\_Months 0.000540 0.000540 1 64.080 0.0550 0.8154080

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised 0.013209 0.013209 1 64.122 1.3442 0.2505999

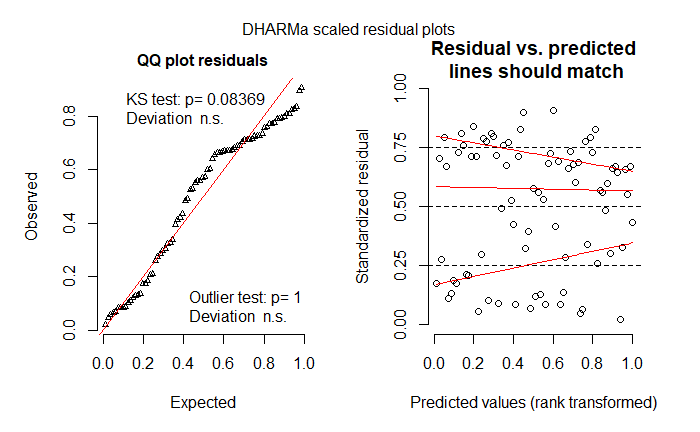
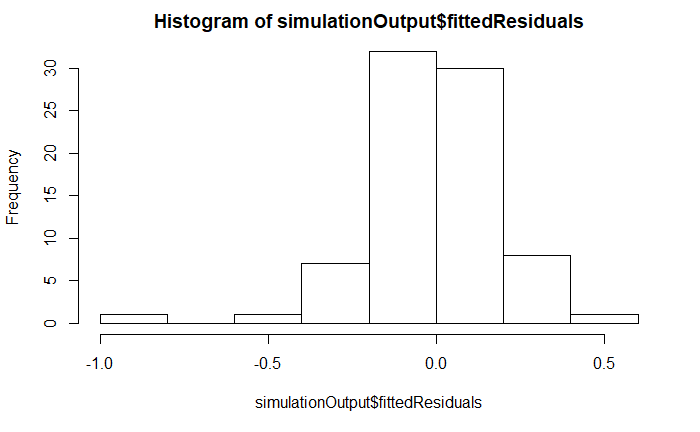
Estuary\_Type:Drought\_Months 0.189303 0.094652 2 64.016 9.6317 0.0002204 \*\*\*

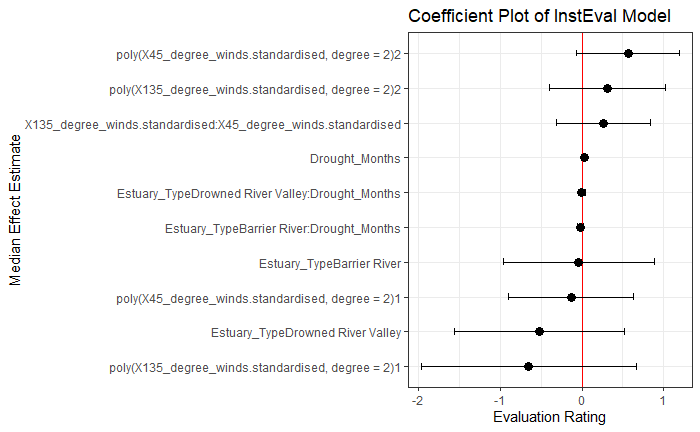
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Whiting (r2m = 0.127, r2c = 0.874):

Assumptions (border-line):





Summary:

Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']

Formula: log10(CPUE) ~ poly(X135\_degree\_winds.standardised, degree = 2) +

poly(X45\_degree\_winds.standardised, degree = 2) + X135\_degree\_winds.standardised:X45\_degree\_winds.standardised +

Estuary\_Type \* Drought\_Months + (1 | Estuary)

Data: whiting

REML criterion at convergence: 38.3

Scaled residuals:

Min 1Q Median 3Q Max

-3.9245 -0.4406 -0.0127 0.5141 2.1063

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 0.31691 0.5629

Residual 0.05325 0.2308

Number of obs: 80, groups: Estuary, 8

Fixed effects:

Estimate Std. Error df t value Pr(>|t|)

(Intercept) 7.870e-01 3.311e-01 5.185e+00 2.377 0.0616 .

poly(X135\_degree\_winds.standardised, degree = 2)1 -6.411e-01 6.692e-01 6.698e+01 -0.958 0.3416

poly(X135\_degree\_winds.standardised, degree = 2)2 2.909e-01 3.574e-01 6.499e+01 0.814 0.4187

poly(X45\_degree\_winds.standardised, degree = 2)1 -1.573e-01 3.804e-01 6.709e+01 -0.413 0.6806

poly(X45\_degree\_winds.standardised, degree = 2)2 5.511e-01 3.035e-01 6.446e+01 1.816 0.0740 .

Estuary\_TypeBarrier River -4.645e-02 4.671e-01 5.134e+00 -0.099 0.9245

Estuary\_TypeDrowned River Valley -5.131e-01 5.227e-01 5.152e+00 -0.982 0.3701

Drought\_Months 2.917e-02 1.328e-02 6.426e+01 2.197 0.0316 \*

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised 2.627e-01 2.840e-01 6.451e+01 0.925 0.3583

Estuary\_TypeBarrier River:Drought\_Months -1.654e-02 1.780e-02 6.415e+01 -0.929 0.3563

Estuary\_TypeDrowned River Valley:Drought\_Months 3.509e-05 2.038e-02 6.410e+01 0.002 0.9986

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

ANOVA:

Type III Analysis of Variance Table with Satterthwaite's method

Sum Sq Mean Sq NumDF DenDF F value Pr(>F)

poly(X135\_degree\_winds.standardised, degree = 2) 0.05488 0.02744 2 65.636 0.5153 0.599718

poly(X45\_degree\_winds.standardised, degree = 2) 0.19879 0.09940 2 65.664 1.8665 0.162776

Estuary\_Type 0.05903 0.02952 2 5.139 0.5543 0.605382

Drought\_Months 0.46385 0.46385 1 64.279 8.7103 0.004412 \*\*

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised 0.04558 0.04558 1 64.511 0.8559 0.358341

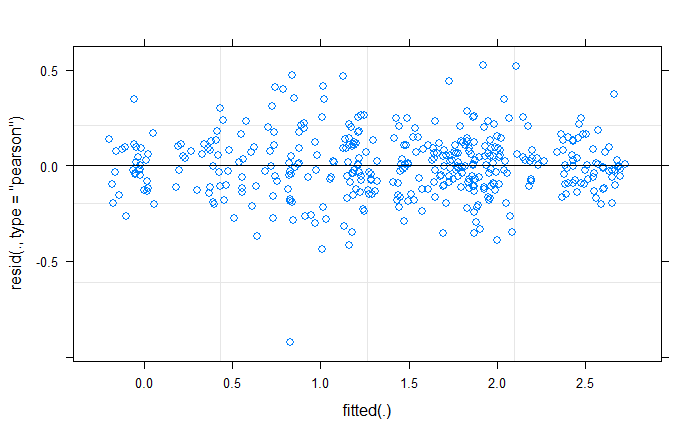
Estuary\_Type:Drought\_Months 0.05898 0.02949 2 64.123 0.5538 0.577497

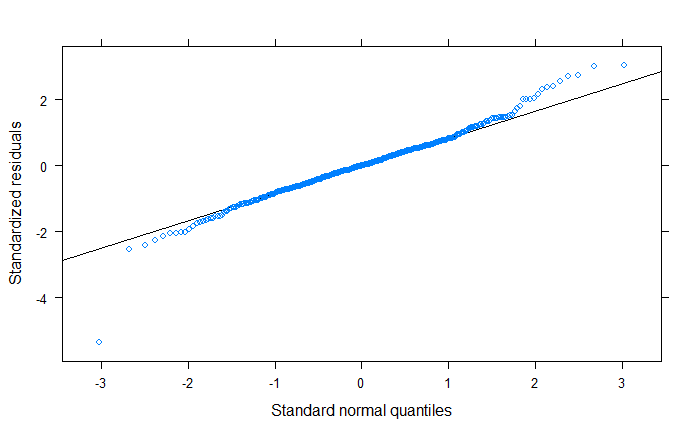
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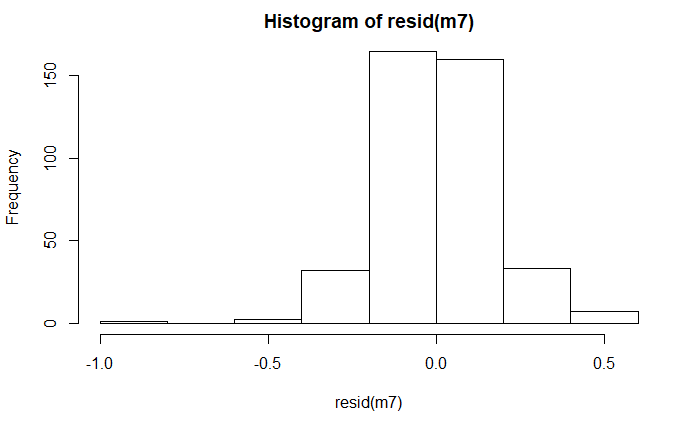
Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Single Model – Species as Random Effect

Assumptions (OK – Not great)







Summary:

summary(m7)

Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']

Formula: log10(CPUE) ~ poly(X135\_degree\_winds.standardised, degree = 2) +

poly(X45\_degree\_winds.standardised, degree = 2) + X135\_degree\_winds.standardised:X45\_degree\_winds.standardised +

Estuary\_Type \* Drought\_Months + (Species | Estuary)

Data: my.df

REML criterion at convergence: -88.9

Scaled residuals:

Min 1Q Median 3Q Max

-5.3334 -0.5751 -0.0016 0.5416 3.0168

Random effects:

Groups Name Variance Std.Dev. Corr

Estuary (Intercept) 0.66070 0.8128

SpeciesFlathead 0.23323 0.4829 0.31

SpeciesLuderick 0.19578 0.4425 0.23 0.81

SpeciesMullet 0.33801 0.5814 -0.07 0.38 0.61

SpeciesWhiting 0.64602 0.8038 -0.27 0.50 0.09 -0.37

Residual 0.02985 0.1728

Number of obs: 400, groups: Estuary, 8

Fixed effects:

Estimate Std. Error df t value Pr(>|t|)

(Intercept) 0.713512 0.188550 3.570006 3.784 0.023789 \*

poly(X135\_degree\_winds.standardised, degree = 2)1 -0.721393 0.528822 134.080965 -1.364 0.174805

poly(X135\_degree\_winds.standardised, degree = 2)2 0.540566 0.317635 351.072100 1.702 0.089669 .

poly(X45\_degree\_winds.standardised, degree = 2)1 -3.230530 0.587493 54.233550 -5.499 1.06e-06 \*\*\*

poly(X45\_degree\_winds.standardised, degree = 2)2 0.802075 0.301327 136.740162 2.662 0.008703 \*\*

Estuary\_TypeBarrier River 0.875051 0.184811 12.287381 4.735 0.000454 \*\*\*

Estuary\_TypeDrowned River Valley 1.131521 0.205728 12.213788 5.500 0.000128 \*\*\*

Drought\_Months 0.025325 0.004387 354.781472 5.773 1.70e-08 \*\*\*

X135\_degree\_winds.standardised:X45\_degree\_winds.standardised -0.026747 0.020498 203.178126 -1.305 0.193409

Estuary\_TypeBarrier River:Drought\_Months -0.026869 0.005779 355.097333 -4.649 4.70e-06 \*\*\*

Estuary\_TypeDrowned River Valley:Drought\_Months -0.015700 0.006807 354.901586 -2.307 0.021654 \*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:

(Intr) p(X135\_\_.,d=2)1 p(X135\_\_.,d=2)2 p(X45\_\_.,d=2)1 p(X45\_\_.,d=2)2 Es\_TBR Es\_TDRV Drgh\_M X135\_\_ E\_TBR:

p(X135\_\_.,d=2)1 0.353

p(X135\_\_.,d=2)2 0.037 -0.459

p(X45\_\_.,d=2)1 0.527 0.119 -0.032

p(X45\_\_.,d=2)2 -0.279 0.001 0.186 -0.555

Estry\_TypBR -0.541 0.008 0.019 -0.018 0.006

Estry\_TyDRV -0.492 0.062 -0.064 -0.114 0.129 0.442

Drght\_Mnths -0.084 0.059 -0.059 -0.096 0.077 0.061 0.085

X135\_\_.:X45 -0.147 0.483 -0.536 0.136 -0.142 0.148 0.069 -0.036

Est\_TBR:D\_M 0.042 -0.071 0.024 0.036 -0.014 -0.099 -0.059 -0.751 -0.009

Es\_TDRV:D\_M 0.056 -0.006 0.007 0.027 -0.032 -0.046 -0.111 -0.635 0.012 0.479

convergence code: 0

Model failed to converge with max|grad| = 0.108474 (tol = 0.002, component 1)

ANOVA:

anova(m7)

Type III Analysis of Variance Table with Satterthwaite's method

Sum Sq Mean Sq NumDF DenDF F value Pr(>F)

poly(X135\_degree\_winds.standardised, degree = 2) 0.09930 0.04965 2 209.12 1.6635 0.1919738

poly(X45\_degree\_winds.standardised, degree = 2) 0.90911 0.45456 2 89.99 15.2300 2.009e-06 \*\*\*

Estuary\_Type 1.09949 0.54975 2 12.26 18.4194 0.0002026 \*\*\*

Drought\_Months 0.53141 0.53141 1 354.12 17.8049 3.113e-05 \*\*\*

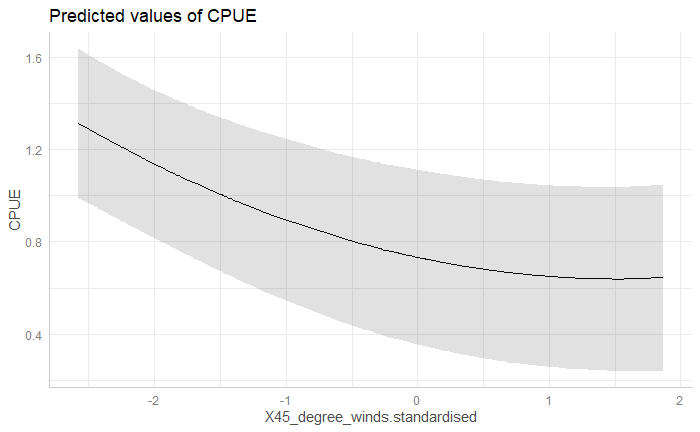
X135\_degree\_winds.standardised:X45\_degree\_winds.standardised 0.05082 0.05082 1 203.18 1.7027 0.1934093

Estuary\_Type:Drought\_Months 0.64544 0.32272 2 355.04 10.8127 2.764e-05 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Basically this shows an overall negative effect of weaker than normal NE winds. Other effects aren’t strong enough to really talk about.



R2m = 0.193, R2c = 0.975