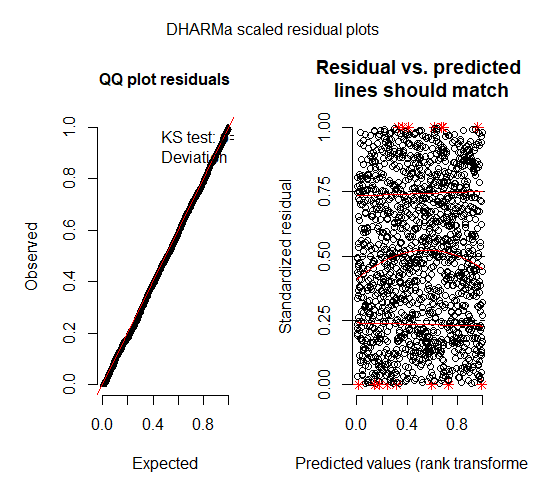
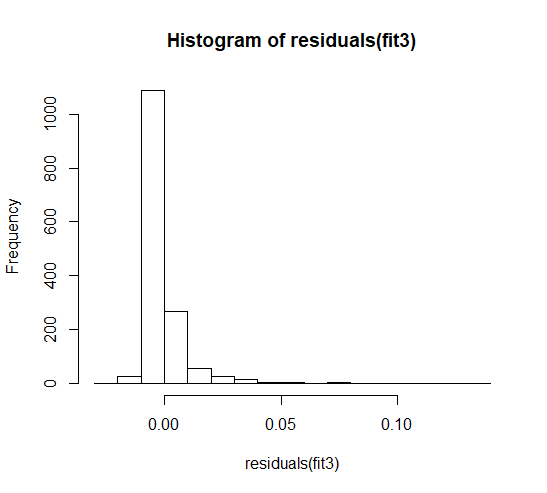
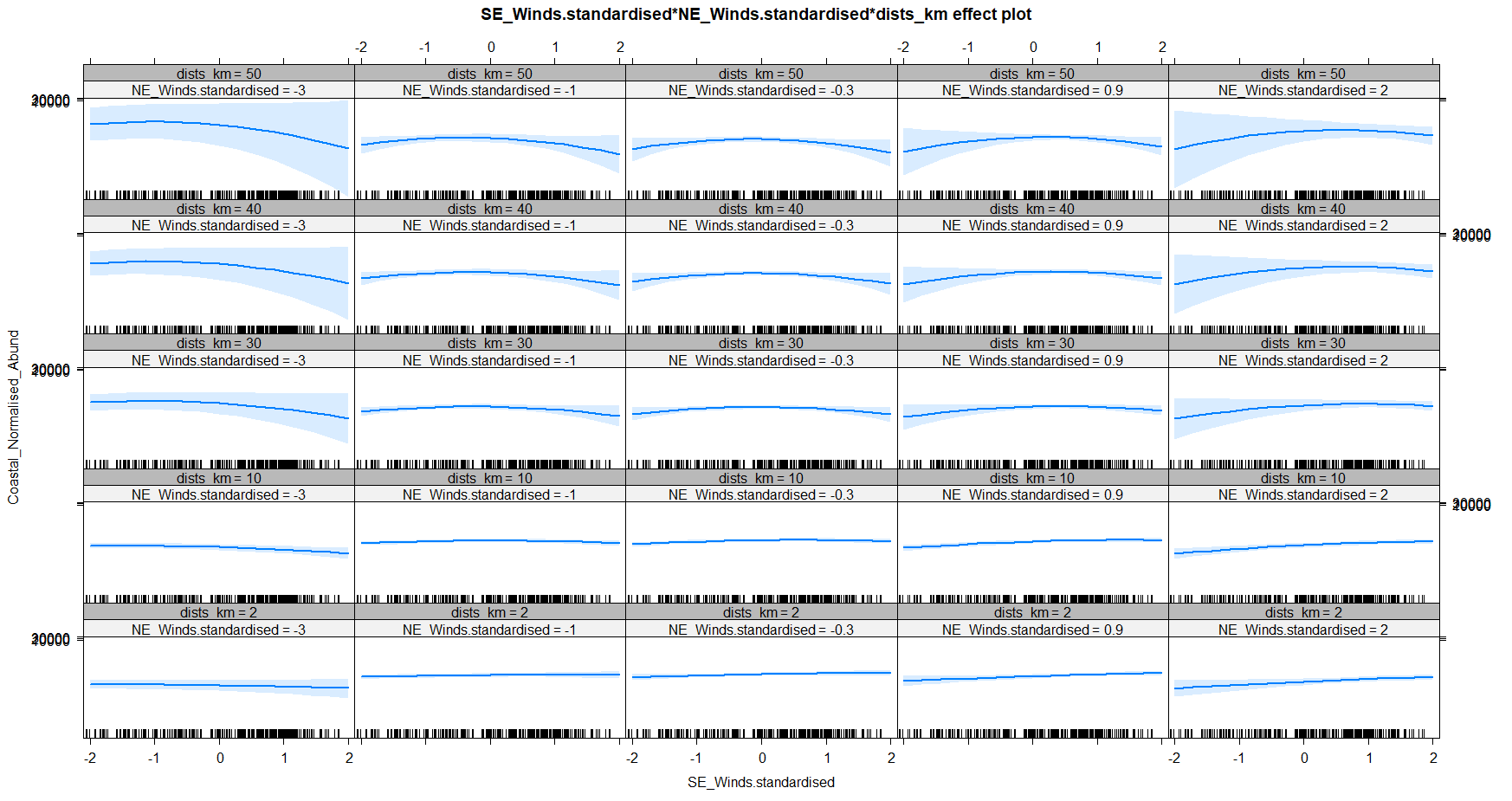
**Model outputs**

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

Model assumptions = good





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) 92.806 5 < 2.2e-16 \*\*\*

dists\_km 11.157 1 0.0008371 \*\*\*

poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2):dists\_km 12.773 5 0.0256012 \*

---

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

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  -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) -5.86430 0.41004 -14.302 < 2e-16 \*\*\*  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)1.0 23.04310 6.59097 3.496 0.000472 \*\*\*  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)2.0 -1.14734 6.49950 -0.177 0.859879  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)0.1 -7.57493 6.12746 -1.236 0.216375  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)1.1 458.83852 355.29058 1.291 0.196549  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)0.2 -28.86505 6.25145 -4.617 3.89e-06 \*\*\*  dists\_km -0.02584 0.01892 -1.366 0.172061  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)1.0:dists\_km -0.27543 0.59632 -0.462 0.644164  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)2.0:dists\_km -0.93506 0.66459 -1.407 0.159437  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)0.1:dists\_km 0.22597 0.52678 0.429 0.667944  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)1.1:dists\_km 14.16494 34.33922 0.413 0.679973  poly(cbind(SE\_Winds.standardised, NE\_Winds.standardised), degree = 2)0.2:dists\_km 1.22635 0.54998 2.230 0.025760 \*  ---  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 \*\*\*

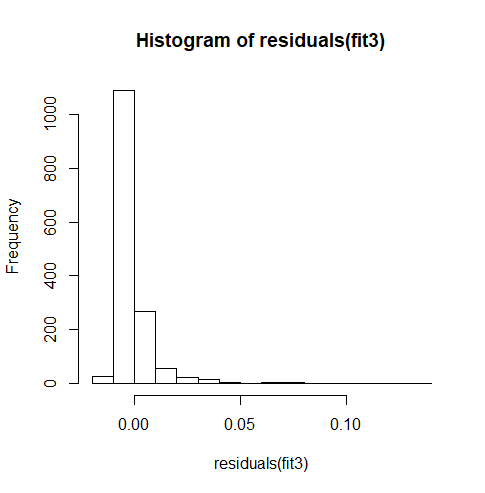
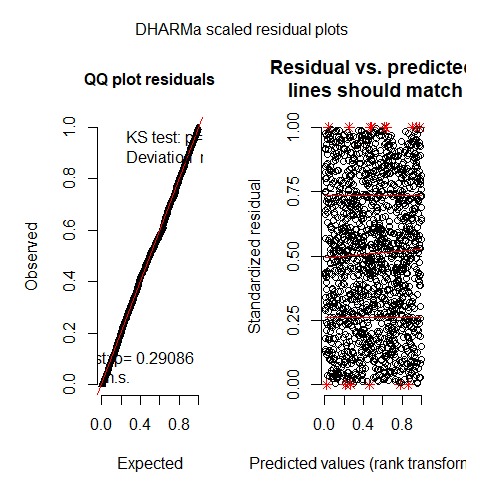
dists\_km:SE\_Winds.standardised:NE\_Winds.standardised 0.1702 1 0.6799674

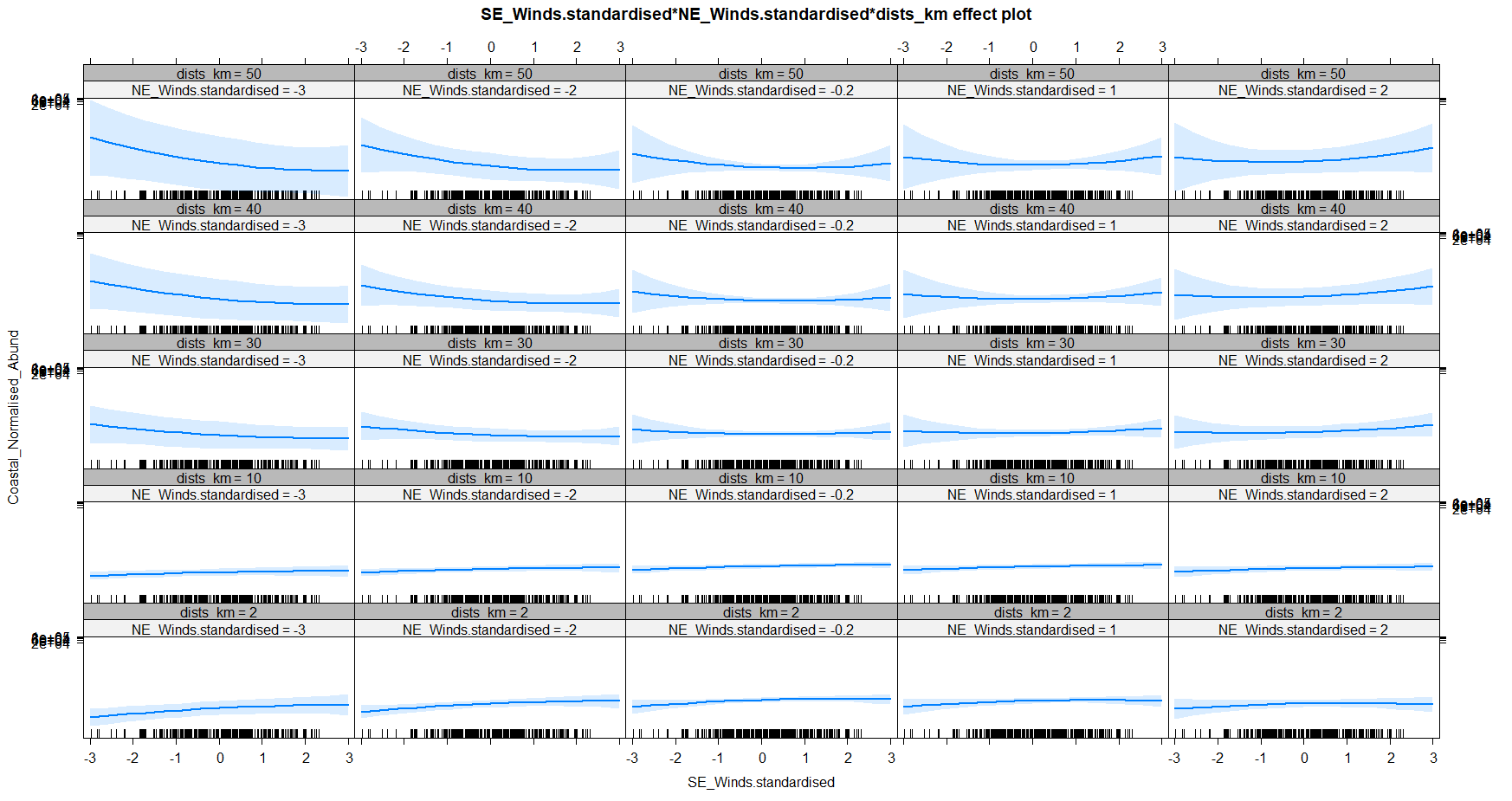
---

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

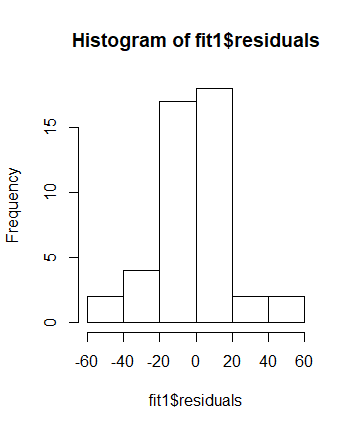
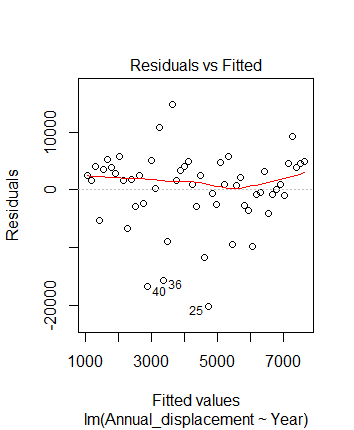
dists\_km:SE\_Winds.standardised:NE\_Winds.standardised 1.0120 1 0.3144258

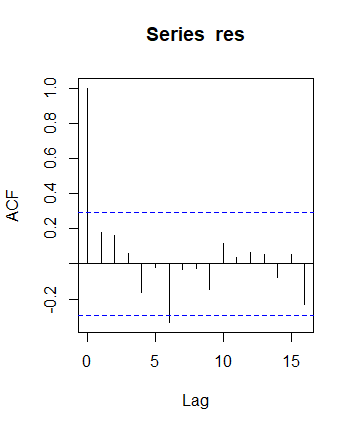
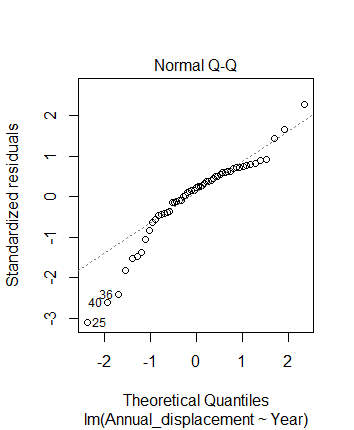
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

**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 \*

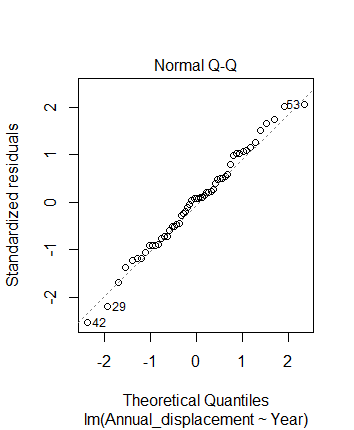
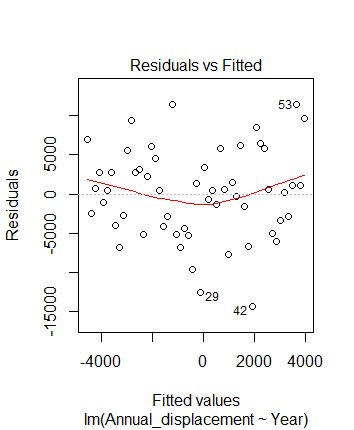
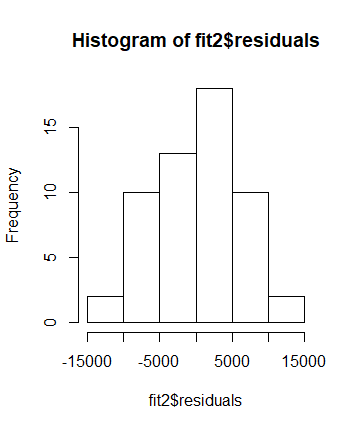
Residuals 43 21088.1 490.42

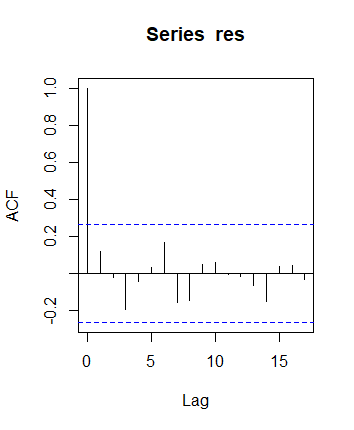
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

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 \*\*

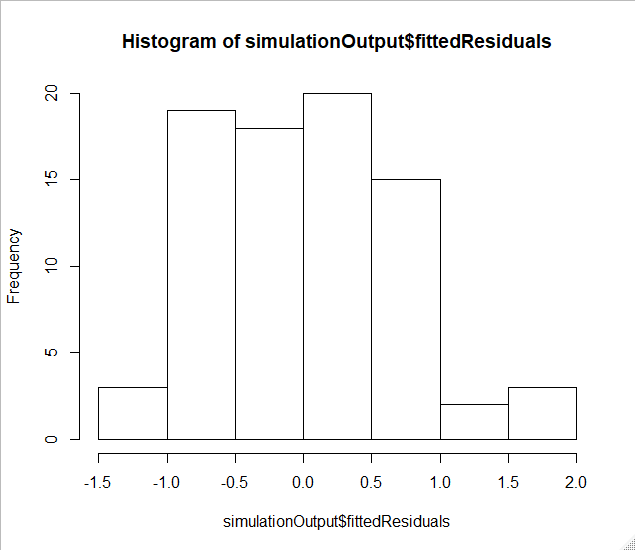
Residuals 53 1763134462 33266688

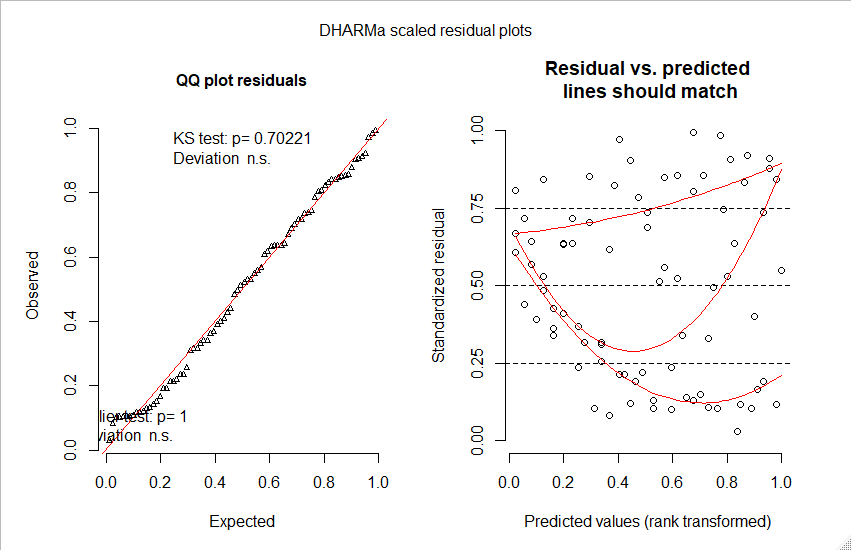
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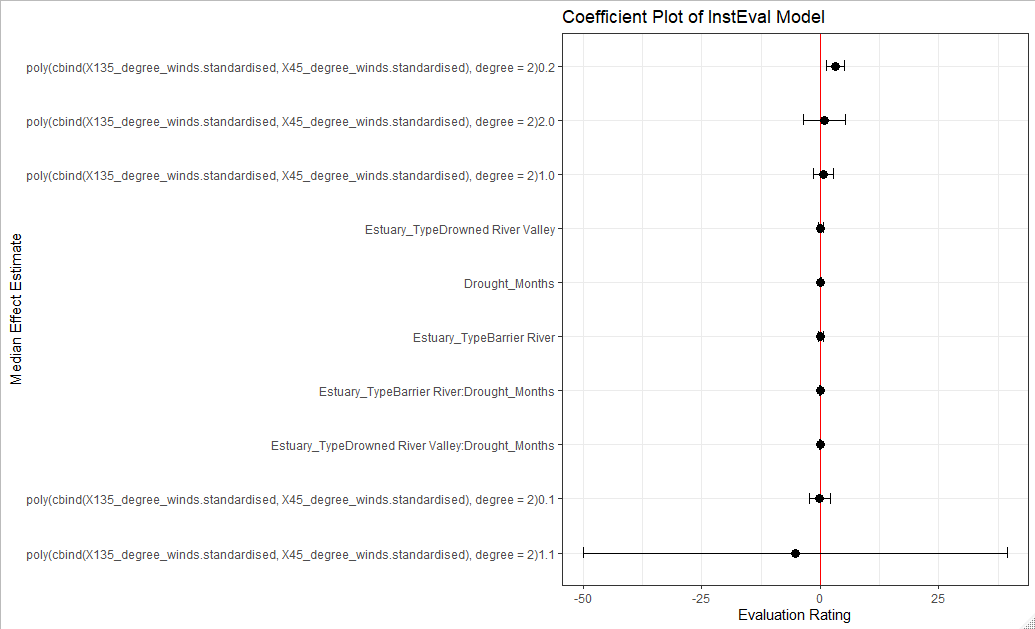
Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Commercial Scale:

Bream:

Assumptions (Not great but acceptable):





Summary:

> m1 <- lmer(CPUE.standardised ~ poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) +

+ Estuary\_Type \* Drought\_Months + (1|Estuary), data = bream)

boundary (singular) fit: see ?isSingular

> plot(m1)

> summary(m1)

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

Formula: CPUE.standardised ~ poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) + Estuary\_Type \*

Drought\_Months + (1 | Estuary)

Data: bream

REML criterion at convergence: 171

Scaled residuals:

Min 1Q Median 3Q Max

-2.02957 -0.78244 0.00195 0.66792 2.45048

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 1.323e-32 1.150e-16

Residual 5.308e-01 7.286e-01

Number of obs: 80, groups: Estuary, 8

Fixed effects:

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

(Intercept) -0.45154 0.26154 69.00000 -1.726 0.08874 .

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.0 0.72390 1.11305 69.00000 0.650 0.51761

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)2.0 0.81954 2.20388 69.00000 0.372 0.71113

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.1 -0.13629 1.12345 69.00000 -0.121 0.90379

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.1 -6.33221 22.72921 69.00000 -0.279 0.78139

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.2 3.24451 0.96581 69.00000 3.359 0.00128 \*\*

Estuary\_TypeBarrier River 0.11006 0.26126 69.00000 0.421 0.67486

Estuary\_TypeDrowned River Valley 0.11864 0.29429 69.00000 0.403 0.68809

Drought\_Months 0.12030 0.04585 69.00000 2.624 0.01069 \*

Estuary\_TypeBarrier River:Drought\_Months -0.03156 0.05536 69.00000 -0.570 0.57050

Estuary\_TypeDrowned River Valley:Drought\_Months -0.03194 0.06407 69.00000 -0.498 0.61977

---

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

Anova:

anova(m1) # bream interaction with winds

> anova(m1) # bream interaction with winds

Type III Analysis of Variance Table with Satterthwaite's method

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

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) 16.0962 3.2192 5 69 6.0644 0.0001039 \*\*\*

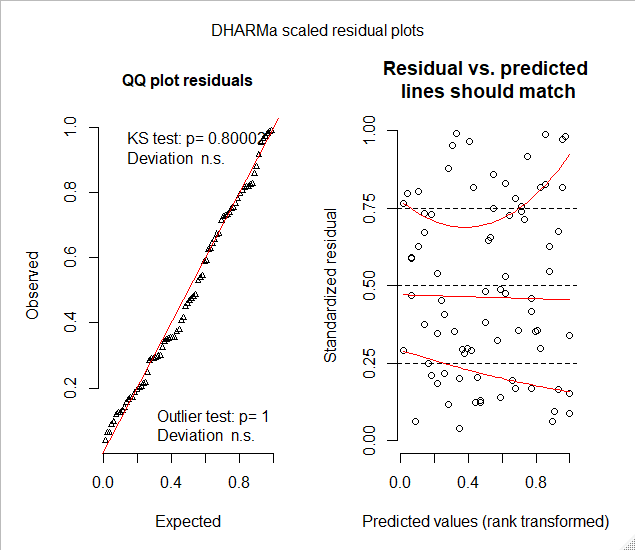
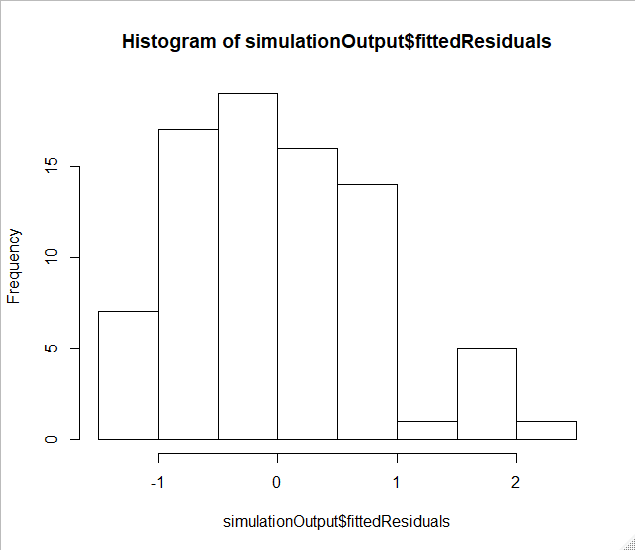
Estuary\_Type 0.1231 0.0616 2 69 0.1160 0.8906629

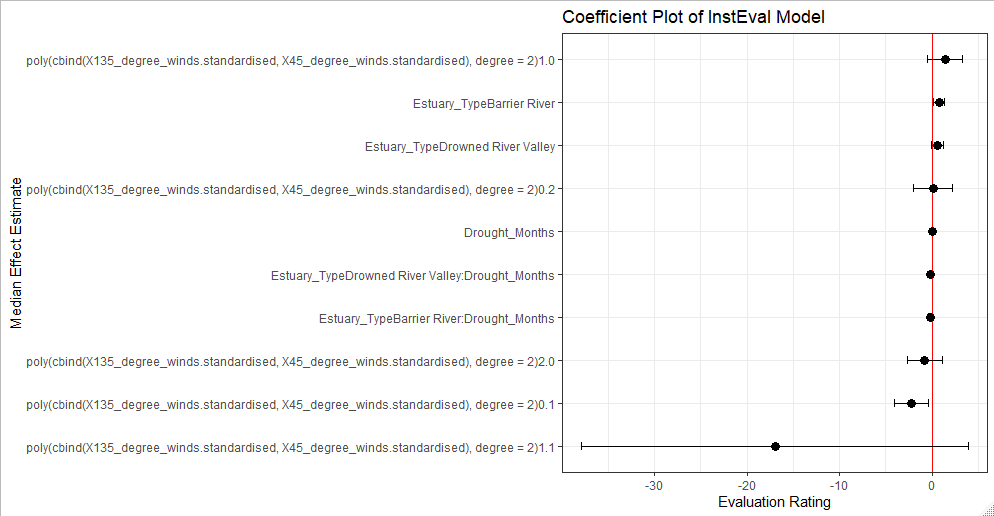
Drought\_Months 5.8543 5.8543 1 69 11.0283 0.0014368 \*\*

Estuary\_Type:Drought\_Months 0.2089 0.1045 2 69 0.1968 0.8218301

Mullet:

Assumptions (OK):





Summary:

> summary(m2)

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

Formula: CPUE.standardised ~ poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) + Estuary\_Type \*

Drought\_Months + (1 | Estuary)

Data: mullet

REML criterion at convergence: 197.6

Scaled residuals:

Min 1Q Median 3Q Max

-1.5915 -0.7117 -0.1014 0.6433 2.5751

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 3.892e-32 1.973e-16

Residual 7.506e-01 8.663e-01

Number of obs: 80, groups: Estuary, 8

Fixed effects:

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

(Intercept) -0.21836 0.24013 69.00000 -0.909 0.36632

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.0 1.49740 0.93595 69.00000 1.600 0.11419

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)2.0 -0.82629 0.94448 69.00000 -0.875 0.38468

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.1 -2.30756 0.94242 69.00000 -2.449 0.01689 \*

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.1 -16.57637 10.18664 69.00000 -1.627 0.10824

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.2 0.02578 1.06187 69.00000 0.024 0.98070

Estuary\_TypeBarrier River 0.75992 0.30879 69.00000 2.461 0.01636 \*

Estuary\_TypeDrowned River Valley 0.56331 0.34990 69.00000 1.610 0.11198

Drought\_Months 0.07994 0.05285 69.00000 1.513 0.13496

Estuary\_TypeBarrier River:Drought\_Months -0.23338 0.06506 69.00000 -3.587 0.00062 \*\*\*

Estuary\_TypeDrowned River Valley:Drought\_Months -0.17502 0.07617 69.00000 -2.298 0.02461 \*

---

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

ANOVA:

> anova(m2) # Wind interaction effects from mullet

Type III Analysis of Variance Table with Satterthwaite's method

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

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) 10.0664 2.0133 5 69 2.6824 0.028359 \*

Estuary\_Type 4.7443 2.3721 2 69 3.1605 0.048607 \*

Drought\_Months 1.9611 1.9611 1 69 2.6129 0.110563

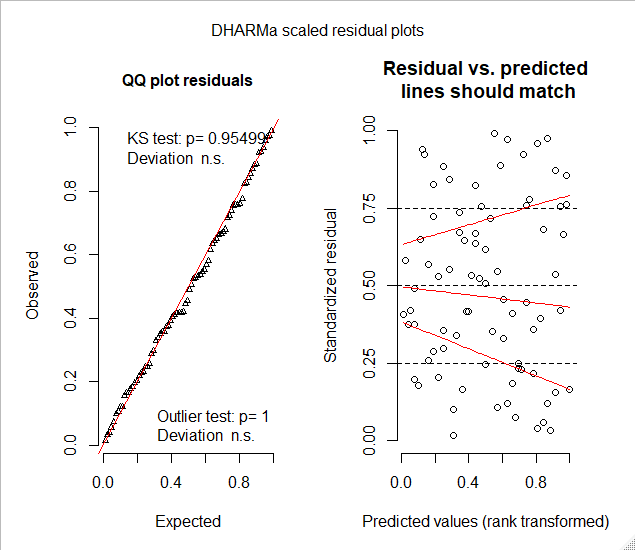
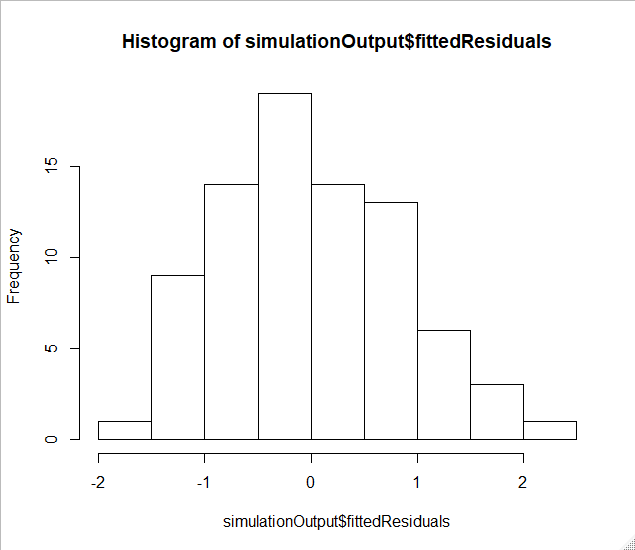
Estuary\_Type:Drought\_Months 9.9984 4.9992 2 69 6.6606 0.002265 \*\*

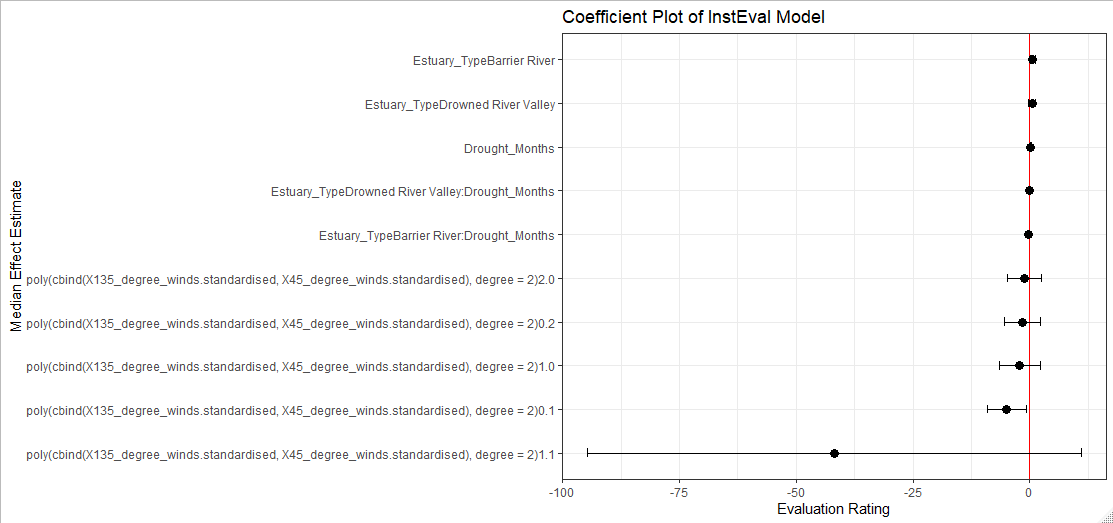
---

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

Luderick:

Assumptions (OK)





Summary:

> summary(m4)

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

Formula: CPUE.standardised ~ poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) + Estuary\_Type \*

Drought\_Months + (1 | Estuary)

Data: luderick

REML criterion at convergence: 202.7

Scaled residuals:

Min 1Q Median 3Q Max

-2.01939 -0.68874 -0.06056 0.58167 2.58320

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 2.141e-32 1.463e-16

Residual 8.487e-01 9.213e-01

Number of obs: 80, groups: Estuary, 8

Fixed effects:

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

(Intercept) -0.77831 0.28078 69.00000 -2.772 0.00716 \*\*

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.0 -2.18951 2.26924 69.00000 -0.965 0.33798

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)2.0 -1.22152 1.77023 69.00000 -0.690 0.49248

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.1 -5.04513 2.02740 69.00000 -2.488 0.01525 \*

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.1 -42.00855 26.77437 69.00000 -1.569 0.12123

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.2 -1.56230 1.91431 69.00000 -0.816 0.41724

Estuary\_TypeBarrier River 0.67125 0.32871 69.00000 2.042 0.04497 \*

Estuary\_TypeDrowned River Valley 0.52997 0.37208 69.00000 1.424 0.15886

Drought\_Months 0.15572 0.05648 69.00000 2.757 0.00745 \*\*

Estuary\_TypeBarrier River:Drought\_Months -0.20439 0.06931 69.00000 -2.949 0.00435 \*\*

Estuary\_TypeDrowned River Valley:Drought\_Months -0.16083 0.08100 69.00000 -1.986 0.05106 .

---

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

ANOVA:

> anova(m4) # weak effect of NE Winds

Type III Analysis of Variance Table with Satterthwaite's method

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

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) 5.4772 1.0954 5 69 1.2907 0.27798

Estuary\_Type 3.7758 1.8879 2 69 2.2245 0.11582

Drought\_Months 0.7318 0.7318 1 69 0.8623 0.35634

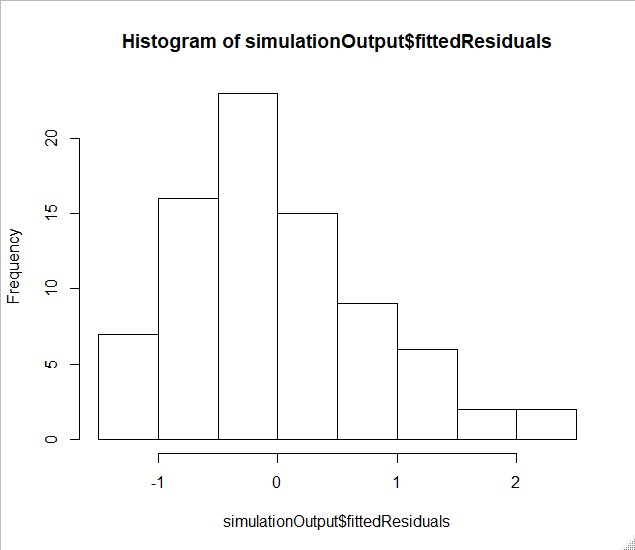
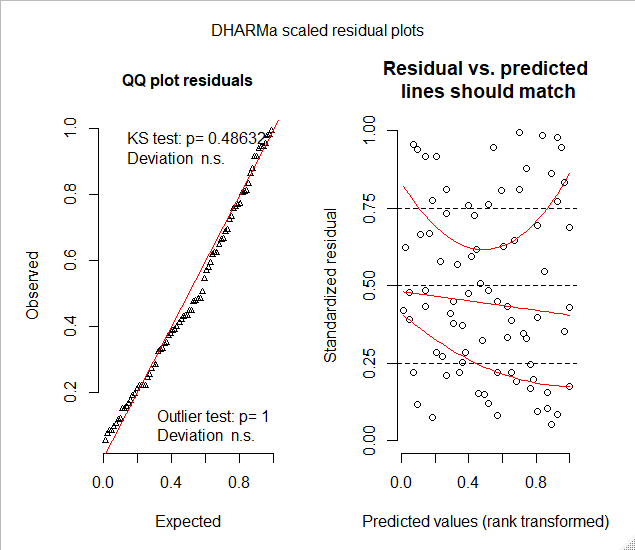
Estuary\_Type:Drought\_Months 7.7588 3.8794 2 69 4.5709 0.01367 \*

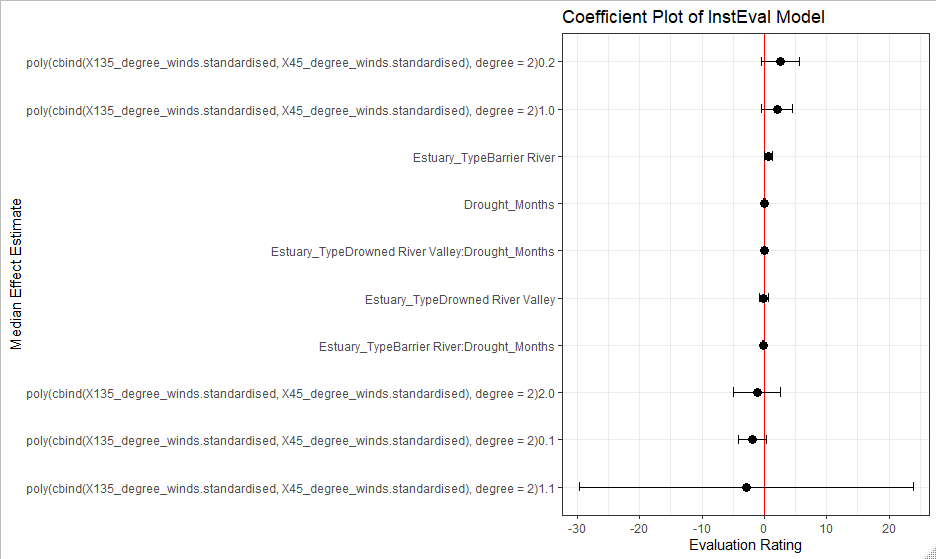
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Flathead:

Assumptions (OK):





Summary:

> summary(m3)

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

Formula: CPUE.standardised ~ poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) + Estuary\_Type \*

Drought\_Months + (1 | Estuary)

Data: flathead

REML criterion at convergence: 195.6

Scaled residuals:

Min 1Q Median 3Q Max

-1.4836 -0.7414 -0.1580 0.5557 2.6655

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 4.040e-32 2.01e-16

Residual 7.448e-01 8.63e-01

Number of obs: 80, groups: Estuary, 8

Fixed effects:

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

(Intercept) -0.17099 0.29161 69.00000 -0.586 0.55954

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.0 2.12107 1.23317 69.00000 1.720 0.08991 .

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)2.0 -0.99616 1.85265 69.00000 -0.538 0.59252

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.1 -1.82202 1.10411 69.00000 -1.650 0.10344

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.1 -1.81962 13.40383 69.00000 -0.136 0.89241

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.2 2.49486 1.49882 69.00000 1.665 0.10054

Estuary\_TypeBarrier River 0.62242 0.31236 69.00000 1.993 0.05026 .

Estuary\_TypeDrowned River Valley -0.08072 0.34855 69.00000 -0.232 0.81754

Drought\_Months 0.05031 0.06762 69.00000 0.744 0.45940

Estuary\_TypeBarrier River:Drought\_Months -0.19146 0.06671 69.00000 -2.870 0.00545 \*\*

Estuary\_TypeDrowned River Valley:Drought\_Months 0.02802 0.07588 69.00000 0.369 0.71304

---

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

ANOVA:

> anova(m3)

Type III Analysis of Variance Table with Satterthwaite's method

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

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) 9.2028 1.8406 5 69 2.4711 0.040581 \*

Estuary\_Type 4.2303 2.1152 2 69 2.8398 0.065287 .

Drought\_Months 0.0050 0.0050 1 69 0.0068 0.934717

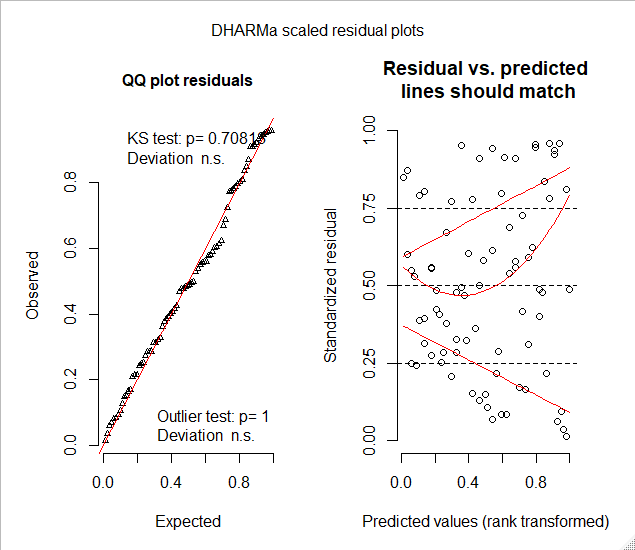
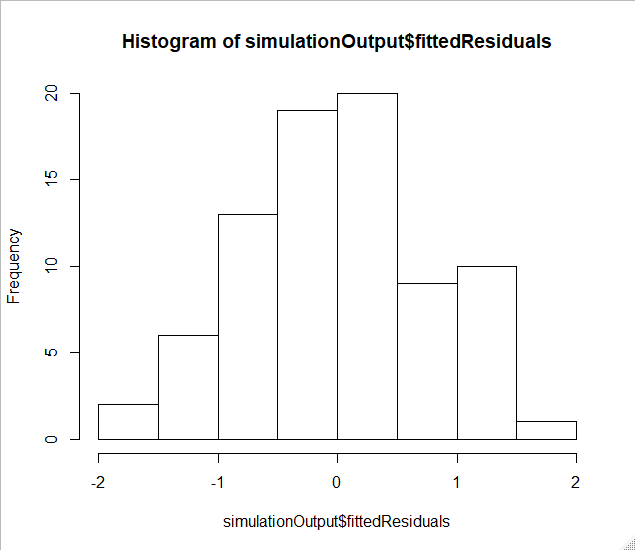
Estuary\_Type:Drought\_Months 8.8276 4.4138 2 69 5.9259 0.004217 \*\*

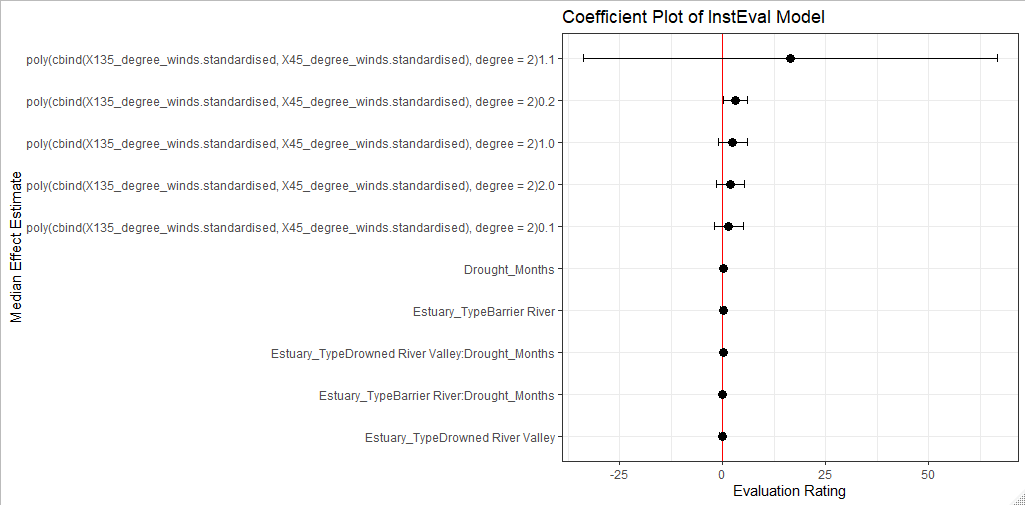
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Whiting:

Assumptions (OK):





Summary:

> summary(m5)

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

Formula: CPUE.standardised ~ poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) + Estuary\_Type \*

Drought\_Months + (1 | Estuary)

Data: whiting

REML criterion at convergence: 191.2

Scaled residuals:

Min 1Q Median 3Q Max

-2.32902 -0.59574 -0.01723 0.60330 2.05556

Random effects:

Groups Name Variance Std.Dev.

Estuary (Intercept) 8.056e-33 8.976e-17

Residual 7.173e-01 8.469e-01

Number of obs: 80, groups: Estuary, 8

Fixed effects:

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

(Intercept) -0.39801 0.27178 69.00000 -1.464 0.14762

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.0 2.31104 1.74002 69.00000 1.328 0.18850

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)2.0 1.84992 1.78185 69.00000 1.038 0.30280

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.1 1.46385 1.79682 69.00000 0.815 0.41805

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.1 16.91494 25.89421 69.00000 0.653 0.51578

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.2 3.03632 1.45140 69.00000 2.092 0.04012 \*

Estuary\_TypeBarrier River 0.08909 0.30298 69.00000 0.294 0.76961

Estuary\_TypeDrowned River Valley -0.16292 0.34196 69.00000 -0.476 0.63528

Drought\_Months 0.15199 0.05177 69.00000 2.936 0.00452 \*\*

Estuary\_TypeBarrier River:Drought\_Months -0.02442 0.06406 69.00000 -0.381 0.70425

Estuary\_TypeDrowned River Valley:Drought\_Months 0.05896 0.07444 69.00000 0.792 0.43108

---

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

ANOVA:

> anova(m5) # drought increases catch of Whiting, no wind effects

Type III Analysis of Variance Table with Satterthwaite's method

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

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) 5.8794 1.1759 5 69 1.6393 0.1612

Estuary\_Type 0.4075 0.2037 2 69 0.2840 0.7536

Drought\_Months 17.0587 17.0587 1 69 23.7812 6.656e-06 \*\*\*

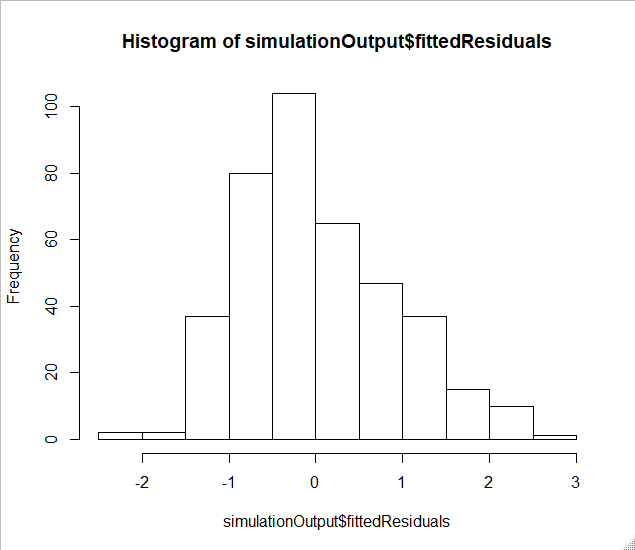
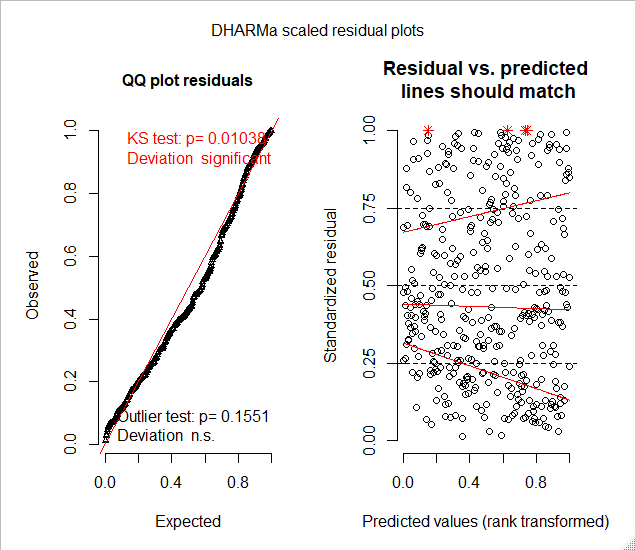
Estuary\_Type:Drought\_Months 0.9707 0.4853 2 69 0.6766 0.5117

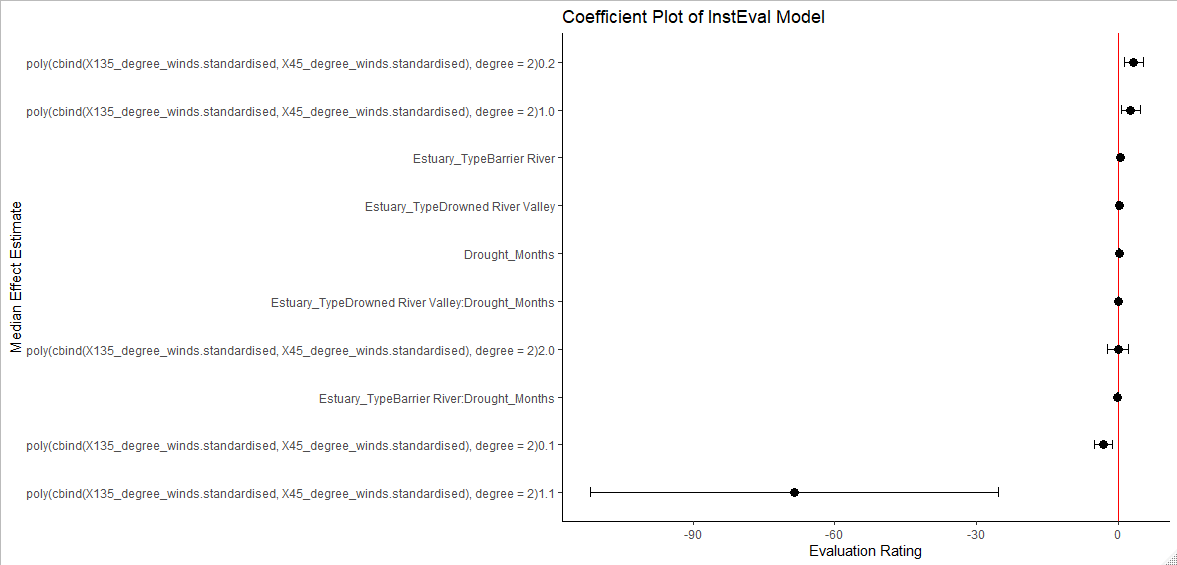
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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

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: CPUE.standardised ~ poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) + Estuary\_Type \*

Drought\_Months + (Species | Estuary)

Data: my.df

REML criterion at convergence: 1041.8

Scaled residuals:

Min 1Q Median 3Q Max

-2.3108 -0.7377 -0.1695 0.6227 2.9020

Random effects:

Groups Name Variance Std.Dev. Corr

Estuary (Intercept) 0.000e+00 0.000e+00

SpeciesFlathead 1.909e-10 1.382e-05 NaN

SpeciesLuderick 7.440e-10 2.728e-05 NaN 1.00

SpeciesMullet 8.982e-10 2.997e-05 NaN 0.46 0.40

SpeciesWhiting 5.855e-10 2.420e-05 NaN 0.55 0.51 0.97

Residual 7.896e-01 8.886e-01

Number of obs: 400, groups: Estuary, 8

Fixed effects:

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

(Intercept) -0.43044 0.10510 388.99979 -4.096 5.13e-05 \*\*\*

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.0 2.58099 1.04177 389.00000 2.478 0.01365 \*

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)2.0 -0.10972 1.13658 389.00000 -0.097 0.92315

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.1 -3.23991 0.98399 389.00000 -3.293 0.00108 \*\*

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)1.1 -69.22519 23.02559 389.00000 -3.006 0.00281 \*\*

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2)0.2 3.17335 0.99329 389.00000 3.195 0.00151 \*\*

Estuary\_TypeBarrier River 0.44973 0.14099 388.99974 3.190 0.00154 \*\*

Estuary\_TypeDrowned River Valley 0.18917 0.16043 388.99976 1.179 0.23907

Drought\_Months 0.11279 0.02267 389.00000 4.975 9.82e-07 \*\*\*

Estuary\_TypeBarrier River:Drought\_Months -0.13677 0.02956 389.00000 -4.627 5.06e-06 \*\*\*

Estuary\_TypeDrowned River Valley:Drought\_Months -0.05468 0.03492 389.00000 -1.566 0.11814

---

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

ANOVA:

> anova(m7) # drought increases catch of Whiting, no wind effects

Type III Analysis of Variance Table with Satterthwaite's method

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

poly(cbind(X135\_degree\_winds.standardised, X45\_degree\_winds.standardised), degree = 2) 28.7369 5.7474 5 389 7.2790 1.558e-06 \*\*\*

Estuary\_Type 8.1414 4.0707 2 389 5.1555 0.0061681 \*\*

Drought\_Months 9.8391 9.8391 1 389 12.4612 0.0004652 \*\*\*

Estuary\_Type:Drought\_Months 17.3519 8.6759 2 389 10.9880 2.280e-05 \*\*\*

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