Chapter 3 Results

# **Occupancy Modeling**

## Longnose Dace:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  | | --- | | lnd.results.p  model npar AICc DeltaAICc weight Deviance  4 p(~1)Psi(~Area\_km2 + pctcbbl + pctSlope + med\_len + BRT\_100m) 7 261.5592 0.0000000 0.4412013038 246.70422  2 p(~pctcbbl)Psi(~Area\_km2 + pctcbbl + pctSlope + med\_len + BRT\_100m) 8 262.2791 0.7198905 0.3078325618 245.17138  6 p(~mFlow)Psi(~Area\_km2 + pctcbbl + pctSlope + med\_len + BRT\_100m) 8 263.7033 2.1441105 0.1510250934 246.59560  8 p(~pctcbbl + mFlow)Psi(~Area\_km2 + pctcbbl + pctSlope + med\_len + BRT\_100m) 9 264.5629 3.0037070 0.0982630179 245.16754  3 p(~1)Psi(~1) 2 274.3253 12.7661035 0.0007456116 14.31515  1 p(~pctcbbl)Psi(~1) 3 275.1556 13.5964559 0.0004922706 268.97786  5 p(~mFlow)Psi(~1) 3 276.3634 14.8042659 0.0002691109 270.18567  7 p(~pctcbbl + mFlow)Psi(~1) 4 277.2700 15.7108356 0.0001710300 268.97151 | |  | | |  | | --- | | > | |   summary(lnd.results.p$p.Dot.Psi.global)#top model  Output summary for Occupancy model  Name : p(~1)Psi(~Area\_km2 + pctcbbl + pctSlope + med\_len + BRT\_100m)  Npar : 7  -2lnL: 246.7042  AICc : 261.5592  Beta  estimate se lcl ucl  p:(Intercept) 0.7802262 0.2388980 0.3119860000 1.2484663  Psi:(Intercept) -2.8416883 0.7096750 -4.2326514000 -1.4507252  Psi:Area\_km2 0.0943358 0.0348234 0.0260820000 0.1625896  Psi:pctcbbl 0.0177740 0.0101424 -0.0021051000 0.0376531  Psi:pctSlope -0.0155181 0.0270784 -0.0685918000 0.0375555  Psi:med\_len 0.0036453 0.0019382 -0.0001534467 0.0074441  Psi:BRT\_100m -0.0969321 0.0347845 -0.1651098000 -0.0287544  Real Parameter p  1 2 3  0.6857289 0.6857289 0.6857289  Real Parameter Psi  1  0.197129  summary(lnd.results.p$p.cobble.Psi.global)#2nd model  Output summary for Occupancy model  Name : p(~pctcbbl)Psi(~Area\_km2 + pctcbbl + pctSlope + med\_len + BRT\_100m)  Npar : 8  -2lnL: 245.1714  AICc : 262.2791  Beta  estimate se lcl ucl  p:(Intercept) 1.5642806 0.7013337 0.1896665000 2.9388946  p:pctcbbl -0.0122874 0.0101726 -0.0322258000 0.0076509  Psi:(Intercept) -2.9138747 0.7215769 -4.3281654000 -1.4995840  Psi:Area\_km2 0.0953914 0.0353726 0.0260612000 0.1647216  Psi:pctcbbl 0.0189937 0.0103232 -0.0012397000 0.0392271  Psi:pctSlope -0.0161102 0.0272300 -0.0694811000 0.0372606  Psi:med\_len 0.0036469 0.0019415 -0.0001583213 0.0074522  Psi:BRT\_100m -0.0973432 0.0349150 -0.1657766000 -0.0289098  Real Parameter p  1 2 3  0.7013709 0.7013709 0.7013709  Real Parameter Psi  1  0.1972493  summary(lnd.results.p$p.flow.Psi.global)#3rd model  Output summary for Occupancy model  Name : p(~mFlow)Psi(~Area\_km2 + pctcbbl + pctSlope + med\_len + BRT\_100m)  Npar : 8  -2lnL: 246.5956  AICc : 263.7033  Beta  estimate se lcl ucl  p:(Intercept) 1.0366281 0.8138597 -0.5585369000 2.6317931  p:mFlow -0.9704725 2.9442255 -6.7411545000 4.8002095  Psi:(Intercept) -2.8490881 0.7105347 -4.2417361000 -1.4564401  Psi:Area\_km2 0.0944780 0.0349088 0.0260568000 0.1628992  Psi:pctcbbl 0.0178164 0.0101487 -0.0020751000 0.0377079  Psi:pctSlope -0.0152891 0.0271978 -0.0685968000 0.0380187  Psi:med\_len 0.0036647 0.0019446 -0.0001467364 0.0074762  Psi:BRT\_100m -0.0970198 0.0348003 -0.1652284000 -0.0288112  Real Parameter p  1 2 3 4 (Psi)  0.690239 0.690239 0.690239 0.1969752 | |

##Examine model list and look at model comparisons

> lnd.results.psi

model npar AICc DeltaAICc weight Deviance

2 p(~1)Psi(~Area\_km2 + pctcbbl + pctSlope + med\_len + BRT\_100m)

7 261.5592 0.000000 0.928180344 246.70422

p(~1)Psi(~med\_len + BRT\_100m) 4 266.9726 5.413426 0.061961501 258.67410

p(~1)Psi(~Area\_km2 + pctcbbl + pctSlope) 5 270.9956 9.436456 0.008289570 260.54451

p(~1)Psi(~1) 2 274.3253 12.766103 0.001568586 14.31515

lnd.results.p$p.Dot.Psi.global$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.6857289 0.0514837 0.5773700 0.7770343

Psi g1 a0 t1 0.1971290 0.0403053 0.1297156 0.2879840

## Southern Redbelly Dace:

|  |  |
| --- | --- |
| |  | | --- | | srd.results.p  model npar AICc DeltaAICc weight Deviance  2 p(~1)Psi(~avgT + avdep + pctfines + med\_len + BRT\_100m) 7 253.1339 0.0000000 6.135489e-01 238.27893  4 p(~mFlow)Psi(~avgT + avdep + pctfines + med\_len + BRT\_100m) 8 254.0584 0.9245105 3.864509e-01 236.95071  1 p(~1)Psi(~1) 2 284.5240 31.3900635 9.366634e-08 16.67921  3 p(~mFlow)Psi(~1) 3 285.3329 32.1990159 6.250601e-08 279.15513  > #Two models <2 DeltaAICc  > summary(srd.results.p$p.Dot.Psi.global) #top model  Output summary for Occupancy model  Name : p(~1)Psi(~avgT + avdep + pctfines + med\_len + BRT\_100m)  Npar : 7  -2lnL: 238.2789  AICc : 253.1339  Beta  estimate se lcl ucl  p:(Intercept) 1.624430e-01 0.2400490 -0.3080530 0.6329390  Psi:(Intercept) -9.842362e+00 2.8293307 -15.3878500 -4.2968737  Psi:avgT 4.886556e-01 0.1622782 0.1705904 0.8067208  Psi:avdep 6.524987e+00 2.9944520 0.6558614 12.3941140  Psi:pctfines -7.635700e-03 0.0114258 -0.0300303 0.0147589  Psi:med\_len -8.677439e-05 0.0025719 -0.0051277 0.0049541  Psi:BRT\_100m -2.214255e-01 0.1346690 -0.4853767 0.0425256  Real Parameter p  1 2 3  0.5405217 0.5405217 0.5405217  Real Parameter Psi  1  0.0918079  > srd.results.p$p.Dot.Psi.global$results$real  estimate se lcl ucl fixed note  p g1 a0 t1 0.5405217 0.0596181 0.4235900 0.6531556  Psi g1 a0 t1 0.0918079 0.0638426 0.0220421 0.3119528  > summary(srd.results.p$p.flow.Psi.global) #2nd model  Output summary for Occupancy model  Name : p(~mFlow)Psi(~avgT + avdep + pctfines + med\_len + BRT\_100m)  Npar : 8  -2lnL: 236.9507  AICc : 254.0584  Beta  estimate se lcl ucl  p:(Intercept) -0.415953700 0.5560697 -1.5058503 0.6739428  p:mFlow 2.302377800 2.0069447 -1.6312339 6.2359895  Psi:(Intercept) -9.923993400 2.8838260 -15.5762930 -4.2716943  Psi:avgT 0.495378200 0.1663385 0.1693546 0.8214018  Psi:avdep 6.469377900 3.0698073 0.4525556 12.4862000  Psi:pctfines -0.007259100 0.0115693 -0.0299349 0.0154167  Psi:med\_len -0.000239252 0.0025410 -0.0052195 0.0047410  Psi:BRT\_100m -0.218558600 0.1325039 -0.4782662 0.0411490  Real Parameter p  1 2 3  0.5355637 0.5355637 0.5355637  Real Parameter Psi  1  0.0937626  > srd.results.p$p.flow.Psi.global$results$real  estimate se lcl ucl fixed note  p g1 a0 t1 0.5355637 0.0600660 0.4180419 0.6492645  Psi g1 a0 t1 0.0937626 0.0643118 0.0229326 0.3132267  srd.results.psi  model npar AICc DeltaAICc weight Deviance  2 p(~1)Psi(~avgT + avdep + pctfines + med\_len + BRT\_100m) 7 253.1339 0.000000 9.671871e-01 238.27893  3 p(~1)Psi(~avgT + avdep + pctfines) 5 260.0342 6.900296 3.069943e-02 249.58306  4 p(~1)Psi(~med\_len + BRT\_100m) 4 265.3861 12.252246 2.113339e-03 257.08763  1 p(~1)Psi(~1) 2 284.5240 31.390063 1.476539e-07 16.67921  summary(srd.results.psi$p.Dot.Psi.habitat) #2nd model (delta AIC = 6.9)  Output summary for Occupancy model  Name : p(~1)Psi(~avgT + avdep + pctfines)  Npar : 5  -2lnL: 249.5831  AICc : 260.0342  Beta  estimate se lcl ucl  p:(Intercept) 0.1603681 0.2401971 -0.3104182 0.6311544  Psi:(Intercept) -12.8754690 2.7519673 -18.2693250 -7.4816128  Psi:avgT 0.6363484 0.1574323 0.3277812 0.9449157  Psi:avdep 5.2690352 2.7106926 -0.0439225 10.5819930  Psi:pctfines 0.0062654 0.0103134 -0.0139489 0.0264797  Real Parameter p  1 2 3  0.5400063 0.5400063 0.5400063  Real Parameter Psi  1  0.1962996  > srd.results.psi$p.Dot.Psi.habitat$results$real  estimate se lcl ucl fixed note  p g1 a0 t1 0.5400063 0.0596648 0.4230127 0.6527512  Psi g1 a0 t1 0.1962996 0.0438787 0.1240408 0.2964084 | |

## Cottus:

cott.results.p

model npar AICc DeltaAICc weight Deviance

6 p(~mFlow)Psi(~avgT + mFlow + HAiFLS\_for + med\_len + BRT\_100m) 8 146.7662 0.000000 6.694930e-01 129.658510

8 p(~pctcbbl + mFlow)Psi(~avgT + mFlow + HAiFLS\_for + med\_len + BRT\_100m) 9 149.0495 2.283257 2.137682e-01 129.654110

4 p(~1)Psi(~avgT + mFlow + HAiFLS\_for + med\_len + BRT\_100m) 7 151.1566 4.390420 7.453814e-02 136.301660

2 p(~pctcbbl)Psi(~avgT + mFlow + HAiFLS\_for + med\_len + BRT\_100m) 8 152.2947 5.528540 4.219285e-02 135.187050

5 p(~mFlow)Psi(~1) 3 170.2823 23.516135 5.239407e-06 164.104560

7 p(~pctcbbl + mFlow)Psi(~1) 4 172.2666 25.500445 1.942651e-06 163.968140

3 p(~1)Psi(~1) 2 175.5223 28.756053 3.814595e-07 1.972209

1 p(~pctcbbl)Psi(~1) 3 176.5365 29.770345 2.297194e-07 170.358770

summary(cott.results.p$p.flow.Psi.global) #top model

Output summary for Occupancy model

Name : p(~mFlow)Psi(~avgT + mFlow + HAiFLS\_for + med\_len + BRT\_100m)

Npar : 8

-2lnL: 129.6585

AICc : 146.7662

Beta

estimate se lcl ucl

p:(Intercept) 3.1275604 0.8099204 1.5401163 4.7150044

p:mFlow -7.3089313 2.9923475 -13.1739320 -1.4439302

Psi:(Intercept) -0.3601489 2.7215329 -5.6943535 4.9740557

Psi:avgT -0.1758527 0.1565290 -0.4826496 0.1309441

Psi:mFlow -8.0781034 4.0868493 -16.0883280 -0.0678786

Psi:HAiFLS\_for 0.0357922 0.0120024 0.0122676 0.0593169

Psi:med\_len 0.0081287 0.0033886 0.0014870 0.0147703

Psi:BRT\_100m 0.0461421 0.0188749 0.0091473 0.0831369

Real Parameter p

1 2 3

0.7949061 0.7949061 0.7949061

Real Parameter Psi

1

0.0510342

> #only one model <2 DeltaAICc

> summary(cott.results.p$p.full.Psi.global) #2nd model

Output summary for Occupancy model

Name : p(~pctcbbl + mFlow)Psi(~avgT + mFlow + HAiFLS\_for + med\_len + BRT\_100m)

Npar : 9

-2lnL: 129.6541

AICc : 149.0495

Beta

estimate se lcl ucl

p:(Intercept) 3.2336465 1.7961024 -0.2867143 6.7540072

p:pctcbbl -0.0017560 0.0264041 -0.0535079 0.0499960

p:mFlow -7.2204589 3.2654196 -13.6206810 -0.8202364

Psi:(Intercept) -0.3568550 2.7209469 -5.6899111 4.9762010

Psi:avgT -0.1758776 0.1564879 -0.4825939 0.1308387

Psi:mFlow -8.0908677 4.0889689 -16.1052470 -0.0764884

Psi:HAiFLS\_for 0.0357753 0.0120015 0.0122523 0.0592983

Psi:med\_len 0.0081265 0.0033876 0.0014869 0.0147661

Psi:BRT\_100m 0.0461578 0.0188650 0.0091824 0.0831333

Real Parameter p

1 2 3

0.799115 0.799115 0.799115

Real Parameter Psi

1

0.0509975

##Examine model list and look at model comparisons

> cott.results.psi

model npar AICc DeltaAICc weight Deviance

2 p(~mFlow)Psi(~avgT + mFlow + HAiFLS\_for + med\_len + BRT\_100m) 8 146.7662 0.00000 9.957224e-01 129.6585

3 p(~mFlow)Psi(~avgT + mFlow + HAiFLS\_for) 6 158.1847 11.41850 3.300975e-03 145.5483

4 p(~mFlow)Psi(~med\_len + BRT\_100m) 5 160.6364 13.87025 9.688415e-04 150.1853

1 p(~mFlow)Psi(~1) 3 170.2823 23.51614 7.792456e-06 164.1046

cott.results.psi$p.flow.Psi.global$results$real

estimate se lcl ucl

p g1 a0 t1 0.7949061 0.0612636 0.6498150 0.8900533

Psi g1 a0 t1 0.0510342 0.0264141 0.0181302 0.1354190

# **CPUE comparisons and modeling:**

## Comparisons of CPUE b/w sites with and without Brown Trout:

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>

> # Mann Whitney U / Wilcox Sign Rank Test

>

> # using subsetted data -- only when SGCNs of interest are present

> #-----

> #LND

> #-----

> class(ldace$BRT)

[1] "factor"

> wilcox.test(ldace$LND\_CPUE ~ ldace$BRT, mu=0, alt="two.sided", conf.int=T, conf.level=0.95, paired=F,

+ exact=F)

Wilcoxon rank sum test with continuity correction

data: ldace$LND\_CPUE by ldace$BRT

W = 135, p-value = 0.9564

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-1.777859 2.191316

sample estimates:

difference in location

0.04975342

> #-----

> #SRD

> #-----

> class(sdace$BRT)

[1] "factor"

> wilcox.test(sdace$SRD\_CPUE ~ sdace$BRT, mu=0, alt="two.sided", conf.int=T, conf.level=0.95, paired=F,

+ exact=F)

Wilcoxon rank sum test with continuity correction

data: sdace$SRD\_CPUE by sdace$BRT

W = 157.5, p-value = 0.2456

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-0.3134583 4.5286369

sample estimates:

difference in location

0.4347949

> #no difference

> #-----

> #Cottus

> #-----

> class(cott$BRT)

[1] "factor"

> wilcox.test(cott$Cottus\_CPUE ~ cott$BRT, mu=0, alt="two.sided", conf.int=T, conf.level=0.95, paired=F,

+ exact=F)

Wilcoxon rank sum test with continuity correction

data: cott$Cottus\_CPUE by cott$BRT

W = 18, p-value = 1

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-68.49425 49.15872

sample estimates:

difference in location

0.5416241

> #LND

> wilcox\_test(LND\_CPUE~BRT, data=ldace, distribution="exact") #p = 0.95

Exact Wilcoxon-Mann-Whitney Test

data: LND\_CPUE by BRT (0, 1)

Z = 0.072907, p-value = 0.9497

alternative hypothesis: true mu is not equal to 0

> #SRD

> wilcox\_test(SRD\_CPUE~BRT, data=sdace, distribution="exact") #p = 0.25

Exact Wilcoxon-Mann-Whitney Test

data: SRD\_CPUE by BRT (0, 1)

Z = 1.1797, p-value = 0.2457

alternative hypothesis: true mu is not equal to 0

> #Cottus

> wilcox\_test(Cottus\_CPUE~BRT, data=cott, distribution="exact") #p = 1

Exact Wilcoxon-Mann-Whitney Test

data: Cottus\_CPUE by BRT (0, 1)

Z = 0, p-value = 1

alternative hypothesis: true mu is not equal to 0

> #LND

> oneway\_test(LND\_CPUE~BRT, data=ldace,

+ distribution=approximate(B=9999)) #p = 0.95

Approximative Two-Sample Fisher-Pitman Permutation Test

data: LND\_CPUE by BRT (0, 1)

Z = -0.07401, p-value = 0.9424

alternative hypothesis: true mu is not equal to 0

> #SRD

> oneway\_test(SRD\_CPUE~BRT, data=sdace,

+ distribution=approximate(B=9999)) #p = 0.16

Approximative Two-Sample Fisher-Pitman Permutation Test

data: SRD\_CPUE by BRT (0, 1)

Z = 1.3951, p-value = 0.1637

alternative hypothesis: true mu is not equal to 0

> #Cottus

> oneway\_test(Cottus\_CPUE~BRT, data=cott,

+ distribution=approximate(B=9999)) #p = 0.91

Approximative Two-Sample Fisher-Pitman Permutation Test

data: Cottus\_CPUE by BRT (0, 1)

Z = 0.19465, p-value = 0.9166

alternative hypothesis: true mu is not equal to 0

# CPUE Modeling Results:

## Longnose Dace:

summary(lnd.full.mod)

Top Model

Call:

zeroinfl(formula = LND\_ab ~ avwid + pctcbbl + pctSlope + med\_len + BRT\_100m |

1, data = newdata, offset = log(SegLen), dist = "negbin")

Pearson residuals:

Min 1Q Median 3Q Max

-0.2997 -0.2938 -0.2850 -0.2518 7.9494

Count model coefficients (negbin with log link):

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

(Intercept) -7.723982 1.112132 -6.945 3.78e-12 \*\*\*

avwid 0.746383 0.318024 2.347 0.01893 \*

pctcbbl 0.018577 0.015538 1.196 0.23187

pctSlope -0.078077 0.040156 -1.944 0.05185 .

med\_len 0.002687 0.004186 0.642 0.52095

BRT\_100m -0.080822 0.029557 -2.734 0.00625 \*\*

Log(theta) -2.409503 0.212184 -11.356 < 2e-16 \*\*\*

Zero-inflation model coefficients (binomial with logit link):

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

(Intercept) -8.764 49.718 -0.176 0.86

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

Theta = 0.0899

Number of iterations in BFGS optimization: 35

Log-likelihood: -188.5 on 8 Df

parms

Est pLL pUL bcaLL bcaUL

count\_(Intercept) -7.724745099 -11.920635170 -6.05191148 -10.163062277 -5.237282810

count\_avwid 0.746678327 0.282935008 1.59415250 -0.015348765 1.246427234

count\_pctcbbl 0.018571577 -0.019220362 0.05674030 -0.016666208 0.059186993

count\_pctSlope -0.078073066 -0.223670599 -0.02195588 -0.172019982 -0.004146306

count\_med\_len 0.002687595 -0.004198554 0.01380220 -0.004896472 0.012599329

count\_BRT\_100m -0.080829722 -0.491908865 -0.03061826 -0.363098536 0.002675183

zero\_(Intercept) -10.455361106 -12.780162788 -8.49216526 -12.451733221 -1.511582566

expparms

Est pLL pUL bcaLL bcaUL

count\_(Intercept) 4.417594e-04 6.651720e-06 0.0023533593 3.856898e-05 0.005314678

count\_avwid 2.109980e+00 1.327019e+00 4.9241540896 9.847684e-01 3.477895028

count\_pctcbbl 1.018745e+00 9.809632e-01 1.0583809105 9.834719e-01 1.060973617

count\_pctSlope 9.248968e-01 7.995785e-01 0.9782833985 8.419623e-01 0.995862278

count\_med\_len 1.002691e+00 9.958102e-01 1.0138978878 9.951155e-01 1.012679035

count\_BRT\_100m 9.223507e-01 6.114581e-01 0.9698457312 6.955179e-01 1.002678765

zero\_(Intercept) 2.879349e-05 2.816086e-06 0.0002050709 3.910938e-06 0.220560650

> summary(lnd.env.mod)

Call:

zeroinfl(formula = LND\_ab ~ avwid + pctcbbl + pctSlope | 1, data = newdata,

offset = log(SegLen), dist = "negbin")

Pearson residuals:

Min 1Q Median 3Q Max

-0.2831 -0.2798 -0.2728 -0.2466 9.4851

Count model coefficients (negbin with log link):

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

(Intercept) -7.35352 1.10184 -6.674 2.49e-11 \*\*\*

avwid 0.57710 0.27589 2.092 0.0365 \*

pctcbbl 0.02070 0.01136 1.823 0.0684 .

pctSlope -0.06575 0.04298 -1.530 0.1261

Log(theta) -2.52316 0.20901 -12.072 < 2e-16 \*\*\*

Zero-inflation model coefficients (binomial with logit link):

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

(Intercept) -9.749 117.426 -0.083 0.934

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

Theta = 0.0802

Number of iterations in BFGS optimization: 59

Log-likelihood: -191.4 on 6 Df

## Sculpins:

summary(cott.full.mod)

Call:

zeroinfl(formula = Cottus\_ab ~ avgT + HAiFLS\_for + mFlow + med\_len + BRT\_100m | 1, data = newdata, offset = log(SegLen),

dist = "negbin")

Pearson residuals:

Min 1Q Median 3Q Max

-0.26738 -0.26138 -0.16368 -0.03422 7.18254

Count model coefficients (negbin with log link):

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

(Intercept) -1.561031 7.997958 -0.195 0.84525

avgT -0.468800 0.494991 -0.947 0.34359

HAiFLS\_for 0.085882 0.022072 3.891 9.98e-05 \*\*\*

mFlow -13.060838 4.605503 -2.836 0.00457 \*\*

med\_len 0.018635 0.008924 2.088 0.03679 \*

BRT\_100m 0.060184 0.038877 1.548 0.12161

Log(theta) -2.631455 0.306384 -8.589 < 2e-16 \*\*\*

Zero-inflation model coefficients (binomial with logit link):

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

(Intercept) -5.133 21.834 -0.235 0.814

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

Theta = 0.072

Number of iterations in BFGS optimization: 35

Log-likelihood: -137.7 on 8 Df

parms.cott

Est pLL pUL bcaLL bcaUL

count\_(Intercept) -1.37079969 -18.599959872 20.10494943 -24.932464825 16.09526724

count\_avgT -0.48094282 -1.841879564 0.45429781 -1.582112118 0.79643030

count\_HAiFLS\_for 0.08575467 0.017181258 0.18369239 0.014231349 0.17511631

count\_mFlow -13.13191973 -43.471900078 -1.94945204 -37.402163857 0.30753202

count\_med\_len 0.01871544 0.003314916 0.04717862 0.005964522 0.05533996

count\_BRT\_100m 0.05963046 -0.086391434 0.19017092 -0.116836387 0.16215207

zero\_(Intercept) -7.84949182 -9.868391857 1.06293769 -36.186105357 -0.32487371

>

> ## compare with normal based approximation

> confint(cott.full.mod)

2.5 % 97.5 %

count\_(Intercept) -17.236741306 14.11467835

count\_avgT -1.438965462 0.50136547

count\_HAiFLS\_for 0.042621445 0.12914180

count\_mFlow -22.087458463 -4.03421849

count\_med\_len 0.001143765 0.03612535

count\_BRT\_100m -0.016013353 0.13638057

zero\_(Intercept) -47.925543842 37.66032368

>

> expparms.cott

Est pLL pUL bcaLL bcaUL

count\_(Intercept) 2.539038e-01 8.358731e-09 5.388706e+08 1.485827e-11 9.774302e+06

count\_avgT 6.182003e-01 1.585193e-01 1.575067e+00 2.055405e-01 2.217611e+00

count\_HAiFLS\_for 1.089539e+00 1.017330e+00 1.201646e+00 1.014333e+00 1.191385e+00

count\_mFlow 1.980978e-06 1.319585e-19 1.423525e-01 5.707509e-17 1.360064e+00

count\_med\_len 1.018892e+00 1.003320e+00 1.048309e+00 1.005982e+00 1.056900e+00

count\_BRT\_100m 1.061444e+00 9.172351e-01 1.209456e+00 8.897308e-01 1.176039e+00

zero\_(Intercept) 3.899501e-04 5.178598e-05 2.894865e+00 1.925636e-16 7.226186e-01

## Southern Redbelly Dace:

summary(srd.full.mod)

Call:

zeroinfl(formula = SRD\_ab ~ avgT + pctfines + avdep + med\_len + BRT\_100m | 1, data = newdata, offset = log(SegLen), dist = "negbin")

Pearson residuals:

Min 1Q Median 3Q Max

-0.41959 -0.38742 -0.26031 -0.01657 5.17630

Count model coefficients (negbin with log link):

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

(Intercept) -17.701774 3.536560 -5.005 5.58e-07 \*\*\*

avgT 0.800421 0.201010 3.982 6.83e-05 \*\*\*

pctfines -0.017629 0.016229 -1.086 0.2774

avdep 3.676087 3.587173 1.025 0.3055

med\_len -0.005156 0.002801 -1.840 0.0657 .

BRT\_100m -0.308615 0.154732 -1.995 0.0461 \*

Log(theta) -1.732043 0.226972 -7.631 2.33e-14 \*\*\*

Zero-inflation model coefficients (binomial with logit link):

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

(Intercept) -9.172 84.719 -0.108 0.914

---

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

Theta = 0.1769

Number of iterations in BFGS optimization: 52

Log-likelihood: -156.1 on 8 Df

parms.srd

Est pLL pUL bcaLL bcaUL

count\_(Intercept) -17.673130196 -25.47295965 -12.696204847 -24.74999399 -12.280395712

count\_avgT 0.798958590 0.46041137 1.254449123 0.48374627 1.298964358

count\_pctfines -0.017652109 -0.04661022 0.016123798 -0.05002931 0.012149007

count\_avdep 3.660855848 -3.16020161 12.730293586 -4.97316765 10.726395604

count\_med\_len -0.005149499 -0.01035594 0.005014264 -0.01340516 0.001056494

count\_BRT\_100m -0.308938657 -1.24201809 -0.146149946 -0.96471711 -0.096949985

zero\_(Intercept) -9.536313720 -10.78007414 -0.601502818 -13.76755024 -9.198393041

>

> ## compare with normal based approximation

> confint(srd.full.mod)

2.5 % 97.5 %

count\_(Intercept) -24.63330520 -1.077024e+01

count\_avgT 0.40644813 1.194394e+00

count\_pctfines -0.04943650 1.417865e-02

count\_avdep -3.35464189 1.070682e+01

count\_med\_len -0.01064645 3.347399e-04

count\_BRT\_100m -0.61188526 -5.345241e-03

zero\_(Intercept) -175.21754651 1.568734e+02

expparms.srd

Est pLL pUL bcaLL bcaUL

count\_(Intercept) 2.111821e-08 8.654375e-12 3.062728e-06 1.783258e-11 4.641859e-06

count\_avgT 2.223224e+00 1.584726e+00 3.505907e+00 1.622140e+00 3.665499e+00

count\_pctfines 9.825028e-01 9.544594e-01 1.016254e+00 9.512015e-01 1.012223e+00

count\_avdep 3.889462e+01 4.241721e-02 3.378288e+05 6.921189e-03 4.554224e+04

count\_med\_len 9.948637e-01 9.896975e-01 1.005027e+00 9.866843e-01 1.001057e+00

count\_BRT\_100m 7.342258e-01 2.888008e-01 8.640281e-01 3.810910e-01 9.076014e-01

zero\_(Intercept) 7.218244e-05 2.081007e-05 5.479913e-01 1.049129e-06 1.012019e-04