Chapter 3 Results

# **Occupancy Modeling**

## Longnose Dace:

lnd.results.p

model npar AICc DeltaAICc weight Deviance

p(~1)Psi(~GLOBAL) 8 232.1214 0.0000000 0.4468482 215.0137

p(~pctcbbl)Psi(~GLOBAL) 9 232.8778 0.7564065 0.3061318 213.4825

p(~mFlow)Psi(~GLOBAL) 9 234.2962 2.1747765 0.1506306 214.9009

p(~pctcbbl + mFlow)Psi(~GLOBAL) 10 235.1891 3.0676477 0.0963893 213.4703

> summary(lnd.results.p$p.Dot.Psi.global)#top model

Output summary for Occupancy model

Name : p(~1)Psi(~Area\_km2 + pctcbbl + elev\_m + avgT + med\_len + BRT\_100m)

Npar : 8

-2lnL: 215.0137

AICc : 232.1214

Beta

estimate se lcl ucl

p:(Intercept) 0.7886324 0.2370637 0.3239876 1.2532771

Psi:(Intercept) -13.7424040 3.4036133 -20.4134860 -7.0713218

Psi:Area\_km2 0.0815432 0.0430690 -0.0028721 0.1659586

Psi:pctcbbl 0.0262324 0.0126095 0.0015178 0.0509471

Psi:elev\_m -0.0155926 0.0067008 -0.0287261 -0.0024590

Psi:avgT 0.9264744 0.2170951 0.5009680 1.3519809

Psi:med\_len 0.0016041 0.0022830 -0.0028705 0.0060787

Psi:BRT\_100m -0.0606896 0.0355451 -0.1303581 0.0089789

Real Parameter p

1 2 3

0.6875376 0.6875376 0.6875376

Real Parameter Psi

1

0.1194406

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

estimate se lcl ucl fixed note

p g1 a0 t1 0.6875376 0.0509283 0.5802958 0.7778666

Psi g1 a0 t1 0.1194406 0.0394681 0.0610394 0.2205914

> summary(lnd.results.p$p.cobble.Psi.global)#2nd model

Output summary for Occupancy model

Name : p(~pctcbbl)Psi(~Area\_km2 + pctcbbl + elev\_m + avgT + med\_len + BRT\_100m)

Npar : 9

-2lnL: 213.4825

AICc : 232.8778

Beta

estimate se lcl ucl

p:(Intercept) 1.5576146 0.6915590 0.2021589 2.9130703

p:pctcbbl -0.0120534 0.0099921 -0.0316378 0.0075311

Psi:(Intercept) -13.8394640 3.4188226 -20.5403560 -7.1385713

Psi:Area\_km2 0.0838281 0.0443854 -0.0031673 0.1708235

Psi:pctcbbl 0.0275105 0.0128240 0.0023754 0.0526456

Psi:elev\_m -0.0155999 0.0066934 -0.0287189 -0.0024808

Psi:avgT 0.9269554 0.2166546 0.5023124 1.3515984

Psi:med\_len 0.0016313 0.0022835 -0.0028444 0.0061069

Psi:BRT\_100m -0.0612748 0.0359630 -0.1317624 0.0092127

Real Parameter p

1 2 3

0.7028076 0.7028076 0.7028076

Real Parameter Psi

1

0.1193774

> lnd.results.p$p.cobble.Psi.global$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.7028076 0.0520978 0.5918997 0.7940614

Psi g1 a0 t1 0.1193774 0.0394964 0.0609555 0.2206368

> summary(lnd.results.p$p.flow.Psi.global)#3rd model

Output summary for Occupancy model

Name : p(~mFlow)Psi(~Area\_km2 + pctcbbl + elev\_m + avgT + med\_len + BRT\_100m)

Npar : 9

-2lnL: 214.9009

AICc : 234.2962

Beta

estimate se lcl ucl

p:(Intercept) 1.0405909 0.7878773 -0.5036487 2.5848305

p:mFlow -0.9550091 2.8440446 -6.5293366 4.6193183

Psi:(Intercept) -13.7652080 3.4061153 -20.4411950 -7.0892223

Psi:Area\_km2 0.0812543 0.0429947 -0.0030154 0.1655239

Psi:pctcbbl 0.0261453 0.0125945 0.0014600 0.0508305

Psi:elev\_m -0.0155597 0.0066998 -0.0286913 -0.0024280

Psi:avgT 0.9274844 0.2175057 0.5011731 1.3537957

Psi:med\_len 0.0016339 0.0022932 -0.0028608 0.0061287

Psi:BRT\_100m -0.0606076 0.0355418 -0.1302696 0.0090543

Real Parameter p

1 2 3

0.6918858 0.6918858 0.6918858

Real Parameter Psi

1

0.1193551

> lnd.results.p$p.flow.Psi.global$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.6918858 0.0522079 0.5815025 0.7839705

Psi g1 a0 t1 0.1193551 0.0394418 0.0609948 0.2204458

> summary(lnd.results.p$p.flow.Psi.global) # 4th model

Output summary for Occupancy model

Name : p(~mFlow)Psi(~Area\_km2 + pctcbbl + elev\_m + avgT + med\_len + BRT\_100m)

Npar : 9

-2lnL: 214.9009

AICc : 234.2962

Beta

estimate se lcl ucl

p:(Intercept) 1.0405909 0.7878773 -0.5036487 2.5848305

p:mFlow -0.9550091 2.8440446 -6.5293366 4.6193183

Psi:(Intercept) -13.7652080 3.4061153 -20.4411950 -7.0892223

Psi:Area\_km2 0.0812543 0.0429947 -0.0030154 0.1655239

Psi:pctcbbl 0.0261453 0.0125945 0.0014600 0.0508305

Psi:elev\_m -0.0155597 0.0066998 -0.0286913 -0.0024280

Psi:avgT 0.9274844 0.2175057 0.5011731 1.3537957

Psi:med\_len 0.0016339 0.0022932 -0.0028608 0.0061287

Psi:BRT\_100m -0.0606076 0.0355418 -0.1302696 0.0090543

Real Parameter p

1 2 3

0.6918858 0.6918858 0.6918858

Real Parameter Psi

1

0.1193551

>

######################## -- LND Occupancy models -- ####################################

lnd.results.psi

model npar AICc DeltaAICc weight Deviance

Psi(~Area\_km2 + pctcbbl + elev\_m + avgT + BRT\_100m) 7 230.3625 0.0000000 3.159084e-01 215.50756

Psi(~Area\_km2 + pctcbbl + elev\_m + avgT) 6 231.2474 0.8848318 2.029656e-01 218.61099

Psi(~Area\_km2 + pctcbbl + elev\_m + avgT + med\_len + BRT\_100m) 8 232.1214 1.7589205 1.311042e-01 215.01375

Psi(~pctcbbl + elev\_m + avgT + BRT\_100m) 6 232.9419 2.5793818 8.698724e-02 220.30554

#look at summary of top model(s) -- 3 within 2AICc & hold double digit weight

> summary(lnd.results.psi$p.Dot.Psi.combo2) ---TOP MODEL---

Output summary for Occupancy model

Name : p(~1)Psi(~Area\_km2 + pctcbbl + elev\_m + avgT + BRT\_100m)

Npar : 7

-2lnL: 215.5076

AICc : 230.3625

Beta

estimate se lcl ucl

p:(Intercept) 0.7868307 0.2374369 3.214543e-01 1.2522070

Psi:(Intercept) -13.9599760 3.4227180 -2.066850e+01 -7.2514487

Psi:Area\_km2 0.0850090 0.0434921 -2.355275e-04 0.1702535

Psi:pctcbbl 0.0287984 0.0120646 5.151900e-03 0.0524450

Psi:elev\_m -0.0163255 0.0066129 -2.928690e-02 -0.0033642

Psi:avgT 0.9519874 0.2162639 5.281100e-01 1.3758647

Psi:BRT\_100m -0.0555609 0.0342907 -1.227707e-01 0.0116490

Real Parameter p

1 2 3

0.6871504 0.6871504 0.6871504

Real Parameter Psi

1

0.1191267

> lnd.results.psi$p.Dot.Psi.combo2$results$real

estimate se lcl ucl

p g1 a0 t1 0.6871504 0.0510429 0.5796786 0.7776817

Psi g1 a0 t1 0.1191267 0.0393898 0.0608563 0.2201146

summary(lnd.results.psi$p.Dot.Psi.habitat) # 2nd model – environment only --

Output summary for Occupancy model

Name : p(~1)Psi(~Area\_km2 + pctcbbl + elev\_m + avgT)

Npar : 6

-2lnL: 218.611

AICc : 231.2474

Beta

estimate se lcl ucl

p:(Intercept) 0.7823878 0.2384095 3.151052e-01 1.2496705

Psi:(Intercept) -15.4437800 3.3193152 -2.194964e+01 -8.9379217

Psi:Area\_km2 0.0683042 0.0388057 -7.755000e-03 0.1443634

Psi:pctcbbl 0.0225937 0.0112367 5.697507e-04 0.0446176

Psi:elev\_m -0.0141943 0.0064995 -2.693320e-02 -0.0014553

Psi:avgT 1.0182769 0.2143316 5.981870e-01 1.4383668

Real Parameter p

1 2 3

0.6861945 0.6861945 0.6861945

Real Parameter Psi

1

0.1259741

> lnd.results.psi$p.Dot.Psi.habitat$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.6861945 0.0513371 0.5781309 0.7772428

Psi g1 a0 t1 0.1259741 0.0395827 0.0665051 0.2257596

summary(lnd.results.psi$p.Dot.Psi.global) # 3rd model

Output summary for Occupancy model

Name : p(~1)Psi(~Area\_km2 + pctcbbl + elev\_m + avgT + med\_len + BRT\_100m)

Npar : 8

-2lnL: 215.0137

AICc : 232.1214

Beta

estimate se lcl ucl

p:(Intercept) 0.7886324 0.2370636 0.3239877 1.2532772

Psi:(Intercept) -13.7424040 3.4036124 -20.4134850 -7.0713239

Psi:Area\_km2 0.0815432 0.0430690 -0.0028721 0.1659585

Psi:pctcbbl 0.0262324 0.0126095 0.0015178 0.0509470

Psi:elev\_m -0.0155926 0.0067008 -0.0287261 -0.0024590

Psi:avgT 0.9264744 0.2170950 0.5009681 1.3519807

Psi:med\_len 0.0016041 0.0022830 -0.0028705 0.0060787

Psi:BRT\_100m -0.0606896 0.0355451 -0.1303581 0.0089789

Real Parameter p

1 2 3

0.6875376 0.6875376 0.6875376

Real Parameter Psi

1

0.1194406

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

estimate se lcl ucl fixed note

p g1 a0 t1 0.6875376 0.0509283 0.5802958 0.7778666

Psi g1 a0 t1 0.1194406 0.0394681 0.0610395 0.2205914

summary(lnd.results.psi$p.Dot.Psi.combo2.3) #FMO

Output summary for Occupancy model

Name : p(~1)Psi(~pctcbbl + elev\_m + avgT + BRT\_100m)

Npar : 6

-2lnL: 220.3055

AICc : 232.9419

Beta

estimate se lcl ucl

p:(Intercept) 0.7718146 0.2403763 0.3006770 1.2429522

Psi:(Intercept) -14.0742290 3.3983447 -20.7349840 -7.4134731

Psi:pctcbbl 0.0276342 0.0116332 0.0048332 0.0504351

Psi:elev\_m -0.0177076 0.0066603 -0.0307617 -0.0046534

Psi:avgT 1.0275599 0.2226105 0.5912434 1.4638764

Psi:BRT\_100m -0.0439675 0.0340196 -0.1106458 0.0227109

Real Parameter p

1 2 3

0.6839133 0.6839133 0.6839133

Real Parameter Psi

1

0.1178156

> lnd.results.psi$p.Dot.Psi.combo2.3$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.6839133 0.0519636 0.5746080 0.7760775

Psi g1 a0 t1 0.1178156 0.0396025 0.0595186 0.2198640

## Southern Redbelly Dace:

srd.results.p

**model npar AICc DeltaAICc weight Deviance**

1 p(~avdep)Psi(~FULL) 8 250.6835 0.000000 0.5417290 233.5758

4 p(~mFlow + avdep)Psi(~FULL) 9 252.6869 2.003437 0.1989488 233.2916

2 p(~1)Psi(~FULL) 7 253.1339 2.450380 0.1591069 238.2789

3 p(~mFlow)Psi(~FULL) 8 254.0584 3.374890 0.1002153 236.9507

#Compare model results - 1 model <2deltaAICc

> summary(srd.results.p$p.depth.Psi.global) #top model

Output summary for Occupancy model

Name : p(~avdep)Psi(~avgT + avdep + pctfines + med\_len + BRT\_100m)

Npar : 8

-2lnL: 233.5758

AICc : 250.6835

Beta

estimate se lcl ucl

p:(Intercept) -2.0876760000 1.1092581 -4.2618219 0.0864699

p:avdep 7.3616931000 3.4250132 0.6486671 14.0747190

Psi:(Intercept) -9.7539963000 3.2442237 -16.1126750 -3.3953176

Psi:avgT 0.5485595000 0.2054129 0.1459501 0.9511689

Psi:avdep 3.4741001000 3.6002616 -3.5824127 10.5306130

Psi:pctfines -0.0077440000 0.0119856 -0.0312357 0.0157477

Psi:med\_len -0.0005730914 0.0027198 -0.0059040 0.0047578

Psi:BRT\_100m -0.2240304000 0.1366898 -0.4919424 0.0438816

Real Parameter p

1 2 3

0.451006 0.451006 0.451006

Real Parameter Psi

1

0.1064082

> srd.results.p$p.depth.Psi.global$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.4510060 0.0816884 0.3008501 0.6106486

Psi g1 a0 t1 0.1064082 0.0752764 0.0246110 0.3597864

> summary(srd.results.p$p.full.Psi.global)

#DeltaAICc = 2.00

Output summary for Occupancy model

Name : p(~mFlow + avdep)Psi(~avgT + avdep + pctfines + med\_len + BRT\_100m)

Npar : 9

-2lnL: 233.2916

AICc : 252.6869

Beta

estimate se lcl ucl

p:(Intercept) -2.2396447000 1.1558143 -4.5050409 0.0257514

p:mFlow 1.0757854000 2.0127220 -2.8691499 5.0207206

p:avdep 6.9672699000 3.5495742 0.0101044 13.9244350

Psi:(Intercept) -9.8703702000 3.2897841 -16.3183470 -3.4223932

Psi:avgT 0.5557249000 0.2101674 0.1437968 0.9676530

Psi:avdep 3.4293294000 3.6457185 -3.7162790 10.5749380

Psi:pctfines -0.0073003000 0.0120254 -0.0308701 0.0162695

Psi:med\_len -0.0006195862 0.0027093 -0.0059298 0.0046906

Psi:BRT\_100m -0.2228913000 0.1355339 -0.4885378 0.0427551

Real Parameter p

1 2 3

0.4529001 0.4529001 0.4529001

Real Parameter Psi

1

0.1064333

> srd.results.p$p.full.Psi.global$results$real

estimate se lcl ucl

p g1 a0 t1 0.4529001 0.0824866 0.3012306 0.6138502

Psi g1 a0 t1 0.1064333 0.0747956 0.0248642 0.3574938

######################## -- SRD Occupancy models -- ####################################

##Examine model list and look at model comparisons

> srd.results.psi

model npar AICc DeltaAICc weight Deviance

15 p(~avdep)Psi(~avgT + BRT\_100m) 5 245.1690 0.000000 4.556800e-01 234.7179

12 p(~avdep)Psi(~avgT + avdep + BRT\_100m) 6 246.6416 1.472616 2.182155e-01 234.0052

13 p(~avdep)Psi(~avgT + pctfines + BRT\_100m) 6 247.0705 1.901526 1.760958e-01 234.4342

11 p(~avdep)Psi(~avgT + avdep + pctfines + BRT\_100m) 7 248.4753 3.306274 8.723921e-02 233.6203

#look at summary of top model(s)

> summary(srd.results.psi$p.depth.Psi.combo2.4) #top model

Output summary for Occupancy model

Name : p(~avdep)Psi(~avgT + BRT\_100m)

Npar : 5

-2lnL: 234.7179

AICc : 245.169

Beta

estimate se lcl ucl

p:(Intercept) -2.6324204 0.8481161 -4.2947279 -0.9701128

p:avdep 8.8777609 2.7336485 3.5198098 14.2357120

Psi:(Intercept) -10.0169540 3.4006510 -16.6822300 -3.3516782

Psi:avgT 0.6127819 0.2129546 0.1953909 1.0301729

Psi:BRT\_100m -0.2351548 0.1191218 -0.4686336 -0.0016760

Real Parameter p

1 2 3

0.4129207 0.4129207 0.4129207

Real Parameter Psi

1

0.1138847

> srd.results.psi$p.depth.Psi.combo2.4$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.4129207 0.0669232 0.2904923 0.5471559

Psi g1 a0 t1 0.1138847 0.0742005 0.0295177 0.3519412

##2nd model (delta AIC = 1.47)

> summary(srd.results.psi$p.depth.Psi.combo2.1)

Output summary for Occupancy model

Name : p(~avdep)Psi(~avgT + avdep + BRT\_100m)

Npar : 6

-2lnL: 234.0052

AICc : 246.6416

Beta

estimate se lcl ucl

p:(Intercept) -2.0598938 1.0767311 -4.1702867 0.0504992

p:avdep 7.2734733 3.3450520 0.7171713 13.8297750

Psi:(Intercept) -10.1690990 3.0474887 -16.1421770 -4.1960207

Psi:avgT 0.5564250 0.1902290 0.1835761 0.9292740

Psi:avdep 3.2653554 3.5248905 -3.6434302 10.1741410

Psi:BRT\_100m -0.2158282 0.1127527 -0.4368235 0.0051672

Real Parameter p

1 2 3

0.4522741 0.4522741 0.4522741

Real Parameter Psi

1

0.107835

> srd.results.psi$p.depth.Psi.combo2.1$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.4522741 0.0794407 0.3057577 0.6075571

Psi g1 a0 t1 0.1078350 0.0674023 0.0297067 0.3230318

##3rd model (delta AIC = 1.90)

> summary(srd.results.psi$p.depth.Psi.combo2.2)

Output summary for Occupancy model

Name : p(~avdep)Psi(~avgT + pctfines + BRT\_100m)

Npar : 6

-2lnL: 234.4342

AICc : 247.0705

Beta

estimate se lcl ucl

p:(Intercept) -2.6603317 0.8514800 -4.3292326 -0.9914308

p:avdep 8.9671688 2.7436434 3.5896277 14.3447100

Psi:(Intercept) -9.4511794 3.4850652 -16.2819070 -2.6204515

Psi:avgT 0.5946847 0.2115584 0.1800302 1.0093392

Psi:pctfines -0.0066658 0.0125531 -0.0312698 0.0179383

Psi:BRT\_100m -0.2590373 0.1339389 -0.5215575 0.0034828

Real Parameter p

1 2 3

0.4117227 0.4117227 0.4117227

Real Parameter Psi

1

0.1054753

> srd.results.psi$p.depth.Psi.combo2.2$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.4117227 0.0669809 0.2892819 0.5461625

Psi g1 a0 t1 0.1054753 0.0742639 0.0245893 0.3554694

## Cottus:

cott.results.p

model npar AICc DeltaAICc weight Deviance

3 p(~mFlow)Psi(~avgT + mFlow + HAiFLS\_for + boulder + med\_len + BRT\_100m) 9 143.9335 0.000000 0.67204317 124.5382

4 p(~pctcbbl + mFlow)Psi(~avgT + mFlow + HAiFLS\_for + boulder + med\_len + BRT\_100m) 10 146.2448 2.311281 0.21159668 124.5261

2 p(~1)Psi(~avgT + mFlow + HAiFLS\_for + boulder + med\_len + BRT\_100m) 8 148.3359 4.402373 0.07437619 131.2282

1 p(~pctcbbl)Psi(~avgT + mFlow + HAiFLS\_for + boulder + med\_len + BRT\_100m) 9 149.4796 5.546070 0.04198396 130.0843

>

> #only one model <2 DeltaAICc

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

Output summary for Occupancy model

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

Npar : 9

-2lnL: 124.5382

AICc : 143.9335

Beta

estimate se lcl ucl

p:(Intercept) 3.1366428 0.8127890 1.5435764 4.7297092

p:mFlow -7.3736623 3.0282668 -13.3090650 -1.4382592

Psi:(Intercept) -1.3831515 2.8490429 -6.9672756 4.2009726

Psi:avgT -0.2150982 0.1589346 -0.5266100 0.0964136

Psi:mFlow -6.7035683 4.1191307 -14.7770650 1.3699280

Psi:HAiFLS\_for 0.0394516 0.0140849 0.0118453 0.0670579

Psi:boulder 1.3140129 0.5945394 0.1487156 2.4793101

Psi:med\_len 0.0098018 0.0040482 0.0018673 0.0177363

Psi:BRT\_100m 0.0463681 0.0204019 0.0063804 0.0863558

Real Parameter p

1 2 3

0.793825 0.793825 0.793825

Real Parameter Psi

1

0.0339142

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

estimate se lcl ucl fixed note

p g1 a0 t1 0.7938250 0.0619248 0.6471543 0.8899001

Psi g1 a0 t1 0.0339142 0.0230668 0.0087552 0.1224398

> #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 + boulder + med\_len + BRT\_100m)

Npar : 10

-2lnL: 124.5261

AICc : 146.2448

Beta

estimate se lcl ucl

p:(Intercept) 3.3033134 1.7298797 -0.0872508 6.6938777

p:pctcbbl -0.0027664 0.0251357 -0.0520323 0.0464995

p:mFlow -7.2374549 3.2600049 -13.6270650 -0.8478451

Psi:(Intercept) -1.3781574 2.8488952 -6.9619921 4.2056773

Psi:avgT -0.2153120 0.1589588 -0.5268713 0.0962474

Psi:mFlow -6.7157150 4.1181799 -14.7873480 1.3559178

Psi:HAiFLS\_for 0.0394368 0.0140847 0.0118307 0.0670428

Psi:boulder 1.3153370 0.5948390 0.1494525 2.4812215

Psi:med\_len 0.0098020 0.0040466 0.0018707 0.0177334

Psi:BRT\_100m 0.0463532 0.0203708 0.0064265 0.0862799

Real Parameter p

1 2 3

0.800256 0.800256 0.800256

Real Parameter Psi

1

0.0338767

> cott.results.p$p.full.Psi.global$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.8002560 0.0839876 0.5885702 0.9181695

Psi g1 a0 t1 0.0338767 0.0230427 0.0087450 0.1223203

> ## continue with d-prob as a function of mFlow

#######################################################################################################################

##Examine model list and look at model comparisons

> cott.results.psi

**model npar AICc DeltaAICc weight Deviance**

p(~mFlow)Psi(~avgT + mFlow + HAiFLS\_for + boulder + med\_len + BRT\_100m) 9 143.9335 0.000000 3.903185e-01 124.5382

p(~mFlow)Psi(~HAiFLS\_for + boulder + BRT\_100m) 6 145.9628 2.029245 1.415058e-01 133.3264

p(~mFlow)Psi(~mFlow + HAiFLS\_for + boulder + BRT\_100m) 7 146.7692 2.835673 9.454978e-02 131.9143

#look at summary of top model(s)

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

Output summary for Occupancy model

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

Npar : 9

-2lnL: 124.5382

AICc : 143.9335

Beta

estimate se lcl ucl

p:(Intercept) 3.1366426 0.8127890 1.5435762 4.7297090

p:mFlow -7.3736619 3.0282670 -13.3090650 -1.4382585

Psi:(Intercept) -1.3831537 2.8490434 -6.9672788 4.2009714

Psi:avgT -0.2150981 0.1589346 -0.5266099 0.0964137

Psi:mFlow -6.7035657 4.1191293 -14.7770590 1.3699279

Psi:HAiFLS\_for 0.0394516 0.0140849 0.0118453 0.0670579

Psi:boulder 1.3140130 0.5945394 0.1487157 2.4793103

Psi:med\_len 0.0098018 0.0040482 0.0018673 0.0177363

Psi:BRT\_100m 0.0463681 0.0204019 0.0063804 0.0863558

Real Parameter p

1 2 3

0.793825 0.793825 0.793825

Real Parameter Psi

1

0.0339142

>

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

estimate se lcl ucl fixed note

p g1 a0 t1 0.7938250 0.0619248 0.6471543 0.8899001

Psi g1 a0 t1 0.0339142 0.0230668 0.0087552 0.1224398

>

> summary(cott.results.psi$p.flow.Psi.combo2.9) #2nd model

Output summary for Occupancy model

Name : p(~mFlow)Psi(~HAiFLS\_for + boulder + BRT\_100m)

Npar : 6

-2lnL: 133.3264

AICc : 145.9628

Beta

estimate se lcl ucl

p:(Intercept) 3.4072493 0.8398116 1.7612186 5.0532801

p:mFlow -9.4447115 3.1650683 -15.6482460 -3.2411774

Psi:(Intercept) -4.4882533 0.8274287 -6.1100135 -2.8664932

Psi:HAiFLS\_for 0.0299644 0.0104411 0.0094999 0.0504289

Psi:boulder 1.3705571 0.5655933 0.2619942 2.4791200

Psi:BRT\_100m 0.0843235 0.0231393 0.0389704 0.1296765

Real Parameter p

1 2 3

0.7533212 0.7533212 0.7533212

Real Parameter Psi

1

0.0745367

>

> cott.results.psi$p.flow.Psi.combo2.9$results$real

estimate se lcl ucl fixed note

p g1 a0 t1 0.7533212 0.0683733 0.5975450 0.8626602

Psi g1 a0 t1 0.0745367 0.0300355 0.0331686 0.1590136

# **CPUE comparisons and modeling:**

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

#############################################################################

>

> # Mann Whitney U / Wilcox Sign Rank Test

>

> #-----

> #LND

> #-----

> #full dataset

> #two sided

> wilcox.test(a, b, mu=0, alt="two.sided", conf.int=T, conf.level=0.95, paired=F,

+ exact=F)

Wilcoxon rank sum test with continuity correction

data: a and b

W = 2307.5, p-value = 0.5831

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-5.583791e-06 2.437085e-05

sample estimates:

difference in location

-4.314327e-05

#-----

> #SRD

> #-----

> #full dataset

> #two sided

> wilcox.test(a3, b3, mu=0, alt="two.sided", conf.int=T, conf.level=0.95, paired=F,

+ exact=F)

Wilcoxon rank sum test with continuity correction

data: a3 and b3

W = 2823.5, p-value = 0.01801

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-4.732444e-05 3.729619e-06

sample estimates:

difference in location

7.413037e-05

> #greater without

> wilcox.test(a3, b3, mu=0, alt="g", conf.int=T, conf.level=0.95, paired=F,

+ exact=F)

Wilcoxon rank sum test with continuity correction

data: a3 and b3

W = 2823.5, p-value = 0.009007

alternative hypothesis: true location shift is greater than 0

95 percent confidence interval:

9.185121e-06 Inf

sample estimates:

difference in location

7.413037e-05

#-----

> #Cottus

> #-----

> #full dataset

> #two sided

> wilcox.test(aa, bb, mu=0, alt="two.sided", conf.int=T, conf.level=0.95, paired=F,

+ exact=F)

Wilcoxon rank sum test with continuity correction

data: aa and bb

W = 1894, p-value = 0.0004144

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-3.932663e-05 -3.271496e-05

sample estimates:

difference in location

-2.911935e-06

> #greater than

> wilcox.test(aa, bb, mu=0, alt="g", conf.int=T, conf.level=0.95, paired=F,

+ exact=F)

Wilcoxon rank sum test with continuity correction

data: aa and bb

W = 1894, p-value = 0.9998

alternative hypothesis: true location shift is greater than 0

95 percent confidence interval:

-8.490874e-06 Inf

sample estimates:

difference in location

-2.911935e-06

>

> #less than without BRT

> wilcox.test(aa, bb, mu=0, alt="l", conf.int=T, conf.level=0.95, paired=F,

+ exact=F)

Wilcoxon rank sum test with continuity correction

data: aa and bb

W = 1894, p-value = 0.0002072

alternative hypothesis: true location shift is less than 0

95 percent confidence interval:

-Inf -2.270222e-05

sample estimates:

difference in location

-2.911935e-06

# 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

---

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

---

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

---

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

# **Size Comparisons:**

## Longnose Dace:

## compare across BRT status and size bins (percentage based %)

> #size class 1

> wilcox.test(lnd.comp2$bin1\_pct ~ lnd.comp2$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: lnd.comp2$bin1\_pct by lnd.comp2$BRT

W = 148, p-value = 0.5162

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-0.0000428524 3.1745892004

sample estimates:

difference in location

5.616438e-05

> # p-value = 0.5162

>

> #size class 2

> wilcox.test(lnd.comp2$bin2\_pct ~ lnd.comp2$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: lnd.comp2$bin2\_pct by lnd.comp2$BRT

W = 114.5, p-value = 0.486

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-28.048764 3.174584

sample estimates:

difference in location

-6.47006e-05

> # p-value = 0.486

>

> #size class 3

> wilcox.test(lnd.comp2$bin3\_pct ~ lnd.comp2$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: lnd.comp2$bin3\_pct by lnd.comp2$BRT

W = 144, p-value = 0.6761

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-3.22578 7.31705

sample estimates:

difference in location

3.427485e-05

> # p-value = 0.6761

## Southern Redbelly Dace:

## compare across BRT status and size bins (percentage based %)

> #size class 1

> wilcox.test(srd.comp2$bin1\_pct ~ srd.comp2$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: srd.comp2$bin1\_pct by srd.comp2$BRT

W = 141.5, p-value = 0.559

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-9.999946 20.833399

sample estimates:

difference in location

2.184342e-05

> # p-value = 0.

>

> #size class 2

> wilcox.test(srd.comp2$bin2\_pct ~ srd.comp2$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: srd.comp2$bin2\_pct by srd.comp2$BRT

W = 117.5, p-value = 0.7572

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-19.9430 11.1111

sample estimates:

difference in location

-6.978875e-05

> # p-value = 0.

>

> #size class 3

> wilcox.test(srd.comp2$bin3\_pct ~ srd.comp2$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: srd.comp2$bin3\_pct by srd.comp2$BRT

W = 126.5, p-value = 1

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-3.553642e-05 1.276333e-05

sample estimates:

difference in location

5.469995e-05

> # p-value = 0.

## Sculpins:

## compare across BRT status and size bins (percentage based %)

> #size class 1

> wilcox.test(cott.comp2$bin1\_pct ~ cott.comp2$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.comp2$bin1\_pct by cott.comp2$BRT

W = 14, p-value = 0.6439

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-50.00001 11.20000

sample estimates:

difference in location

-0.9188509

> #size class 2

> wilcox.test(cott.comp2$bin2\_pct ~ cott.comp2$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.comp2$bin2\_pct by cott.comp2$BRT

W = 25, p-value = 0.412

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-33.33326 42.74281

sample estimates:

difference in location

13.70691

> #size class 3

> wilcox.test(cott.comp2$bin3\_pct ~ cott.comp2$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.comp2$bin3\_pct by cott.comp2$BRT

W = 21, p-value = 0.7496

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-36.80004 33.33333

sample estimates:

difference in location

3.199965

> #size class 4

> wilcox.test(cott.comp2$bin3\_pct ~ cott.comp2$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.comp2$bin3\_pct by cott.comp2$BRT

W = 21, p-value = 0.7496

alternative hypothesis: true location shift is not equal to 0

95 percent confidence interval:

-36.80004 33.33333

sample estimates:

difference in location

3.199965