Ch1\_models\_Blackbear

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Based on model selection comparison of underlying distributions and zero-inflation, I chose an nbinom1 distribution for Blackbear data, with zero-inflation and ActiveDays in the ZI model (see Ch1\_Blackbear\_modelDistribution.Rmd)  
Here I will: 1. Double check random structure using all covariates 2. Build models assessing Treatment effect, including other combinations of covariates to account for additional noise and compare their effect to Treatment 4. Perform model selection with AIC  
5. Calculate evidence ratios (AICwt of Best Model/ AICwt of other models)  
6. Checking residuals of Top Model

Previous scale analysis showed lowland habitat at 500m and linear density measured at 750m best explained Blackbear detections

### 1. Random structure and Active Days

Random structure was previously assessed, but here I will confirm using all model covariates. Models have convergence problems when ActiveDays is run in the zero-inflated part of the model, so here I include it in the conditional

## dLogLik dAIC df weight  
## r2 43.5 0.0 13 1   
## rSite 20.9 43.4 12 <0.001  
## rMonth 17.8 49.5 12 <0.001  
## r0 0.0 83.1 11 <0.001

Continue modelling with 2 random effects. ## Model Set  
(note that numbered models from dredge do not correspond with numbers in table; I have listed models in order of increasing complexity, dredge did not) Also, Blackbear model sets do not include Snow, as they are active in the Snow-free period

## dLogLik dAIC df weight  
## Nullmod 0.0 0.0 6 0.2589  
## 9 3.9 0.3 10 0.2237  
## 13 4.3 1.4 11 0.1301  
## 10 3.9 2.1 11 0.0885  
## 11 3.9 2.3 11 0.0828  
## 14 4.3 3.3 12 0.0495  
## 15 4.3 3.3 12 0.0489  
## 12 3.9 4.1 12 0.0326  
## 16 4.4 5.3 13 0.0185  
## 5 1.3 5.4 10 0.0170  
## 1 0.2 5.5 9 0.0163  
## 3 0.5 7.0 10 0.0077  
## 7 1.4 7.2 11 0.0071  
## 6 1.3 7.4 11 0.0063  
## 2 0.3 7.4 10 0.0062  
## 4 0.6 8.9 11 0.0031  
## 8 1.4 9.2 12 0.0027

Three models within 2 dAIC points of each other, with model weights between 13-25%. Top model is the Null, with only ActiveDays as a covariate

## Evidence Ratios and Cumulative model weight (calculating confidence intervals)

Calculating evidence ratios (AIC wt of best model/AIC weight of others) gives:

## ModelNames dLogLikelihood dAIC Modelweight CumulativeWeight  
## 1 Nullmod 0.0000000 0.0000000 0.258919690 0.2589197  
## 2 9 3.8538745 0.2922509 0.223719375 0.4826391  
## 3 13 4.3120750 1.3758501 0.130137670 0.6127767  
## 4 10 3.9265295 2.1469409 0.088503975 0.7012807  
## 5 11 3.8594365 2.2811270 0.082760792 0.7840415  
## 6 14 4.3457214 3.3085573 0.049513200 0.8335547  
## 7 15 4.3342105 3.3315790 0.048946528 0.8825012  
## 8 12 3.9286103 4.1427794 0.032626611 0.9151278  
## 9 16 4.3616926 5.2766148 0.018508138 0.9336360  
## 10 5 1.2782025 5.4435949 0.017025640 0.9506616  
## 11 1 0.2316054 5.5367892 0.016250495 0.9669121  
## 12 3 0.4904290 7.0191420 0.007744221 0.9746563  
## 13 7 1.4018468 7.1963063 0.007087727 0.9817441  
## 14 6 1.2843866 7.4312267 0.006302236 0.9880463  
## 15 2 0.2753889 7.4492223 0.006245785 0.9942921  
## 16 4 0.5610176 8.8779647 0.003057310 0.9973494  
## 17 8 1.4182704 9.1634592 0.002650606 1.0000000  
## EvidenceRatio  
## 1   
## 2 1.15734137793052  
## 3 1.98958295732634  
## 4 2.92551482501318  
## 5 3.12853083875535  
## 6 5.22930635142987  
## 7 5.28984793886898  
## 8 7.93584385603848  
## 9 13.9895052159901  
## 10 15.2076329481121  
## 11 15.933034194531  
## 12 33.4339218355042  
## 13 36.5307061111807  
## 14 41.083779005433  
## 15 41.4551091909101  
## 16 84.6887149439737  
## 17 97.6832027404597

Examining summaries for top 2 models that aren’t the null (2dAIC)

In addition to ActiveDays and Treatment, both include VegHt and second includes low

## Family: nbinom2 ( log )  
## Formula:   
## Blackbear ~ VegHt\_sc + ActiveDays\_sc + Treatment + (1 | Site) +   
## (1 | Month)  
## Zero inflation: ~1  
## Data: det  
##   
## AIC BIC logLik deviance df.resid   
## 928.8 970.0 -454.4 908.8 445   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## Site (Intercept) 0.8867 0.9416   
## Month (Intercept) 0.5633 0.7505   
## Number of obs: 455, groups: Site, 59; Month, 7  
##   
## Overdispersion parameter for nbinom2 family (): 1.52   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -2.4551 0.6092 -4.030 5.58e-05 \*\*\*  
## VegHt\_sc 1.0011 0.3549 2.821 0.00479 \*\*   
## ActiveDays\_sc 2.8768 0.9622 2.990 0.00279 \*\*   
## TreatmentHumanUse 0.6573 0.5014 1.311 0.18992   
## TreatmentNatRegen -0.2134 0.5082 -0.420 0.67457   
## TreatmentSPP 0.2350 0.4241 0.554 0.57946   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Zero-inflation model:  
## Estimate Std. Error z value Pr(>|z|)  
## (Intercept) -18.07 4664.62 -0.004 0.997

## Family: nbinom2 ( log )  
## Formula:   
## Blackbear ~ low500\_sc + VegHt\_sc + ActiveDays\_sc + Treatment +   
## (1 | Site) + (1 | Month)  
## Zero inflation: ~1  
## Data: det  
##   
## AIC BIC logLik deviance df.resid   
## 929.9 975.2 -453.9 907.9 444   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## Site (Intercept) 0.8779 0.9370   
## Month (Intercept) 0.5630 0.7503   
## Number of obs: 455, groups: Site, 59; Month, 7  
##   
## Overdispersion parameter for nbinom2 family (): 1.53   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -2.5027 0.6109 -4.097 4.19e-05 \*\*\*  
## low500\_sc -0.3268 0.3420 -0.955 0.33934   
## VegHt\_sc 0.9293 0.3616 2.570 0.01017 \*   
## ActiveDays\_sc 2.8607 0.9603 2.979 0.00289 \*\*   
## TreatmentHumanUse 0.7353 0.5059 1.453 0.14609   
## TreatmentNatRegen -0.1907 0.5068 -0.376 0.70665   
## TreatmentSPP 0.3022 0.4287 0.705 0.48079   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Zero-inflation model:  
## Estimate Std. Error z value Pr(>|z|)  
## (Intercept) -18.37 5292.43 -0.003 0.997

### Model averaging

Two models are within 2dAIC scores of each other, suggesting that they all explain the data equally well. As my goal is to compare Treatment effects to the effects of other covariates, I do not just want the estimates given in the top model, but rather the best possible estimates for many covariates. I will therefore model average to obtain a weighted average estimate (effect size) of covariates included in models that are within 2 dAIC of one another or within 95% confidence intervals, whichever is more conservative.

##   
## Call:  
## model.avg(object = Beartop)  
##   
## Component model call:   
## glmmTMB(formula = Blackbear ~ <3 unique rhs>, data = det, family =   
## nbinom2, ziformula = ~1, dispformula = ~1)  
##   
## Component models:   
## df logLik AICc delta weight  
## 1 6 -458.25 928.68 0.00 0.47  
## 134 10 -454.39 929.28 0.60 0.34  
## 1234 11 -453.94 930.47 1.78 0.19  
##   
## Term codes:   
## cond(ActiveDays\_sc) cond(low500\_sc) cond(Treatment)   
## 1 2 3   
## cond(VegHt\_sc)   
## 4   
##   
## Model-averaged coefficients:   
## (full average)   
## Estimate Std. Error Adjusted SE z value Pr(>|z|)  
## cond((Int)) -2.35067 0.58468 0.58619 4.010 6.07e-05  
## cond(ActiveDays\_sc) 2.75119 0.95857 0.96112 2.862 0.0042  
## zi((Int)) -17.90751 4724.86452 4737.70822 0.004 0.9970  
## cond(VegHt\_sc) 0.52190 0.55288 0.55322 0.943 0.3455  
## cond(TreatmentHumanUse) 0.36652 0.50288 0.50362 0.728 0.4668  
## cond(TreatmentNatRegen) -0.10984 0.38529 0.38627 0.284 0.7761  
## cond(TreatmentSPP) 0.13854 0.33794 0.33873 0.409 0.6825  
## cond(low500\_sc) -0.06227 0.19689 0.19720 0.316 0.7522  
##   
## cond((Int)) \*\*\*  
## cond(ActiveDays\_sc) \*\*   
## zi((Int))   
## cond(VegHt\_sc)   
## cond(TreatmentHumanUse)   
## cond(TreatmentNatRegen)   
## cond(TreatmentSPP)   
## cond(low500\_sc)   
##   
## (conditional average)   
## Estimate Std. Error Adjusted SE z value Pr(>|z|)  
## cond((Int)) -2.3507 0.5847 0.5862 4.010 6.07e-05  
## cond(ActiveDays\_sc) 2.7512 0.9586 0.9611 2.862 0.00420  
## zi((Int)) -17.9075 4724.8645 4737.7082 0.004 0.99698  
## cond(VegHt\_sc) 0.9755 0.3589 0.3599 2.710 0.00672  
## cond(TreatmentHumanUse) 0.6851 0.5044 0.5058 1.354 0.17558  
## cond(TreatmentNatRegen) -0.2053 0.5078 0.5092 0.403 0.68679  
## cond(TreatmentSPP) 0.2590 0.4269 0.4281 0.605 0.54525  
## cond(low500\_sc) -0.3268 0.3420 0.3430 0.953 0.34066  
##   
## cond((Int)) \*\*\*  
## cond(ActiveDays\_sc) \*\*   
## zi((Int))   
## cond(VegHt\_sc) \*\*   
## cond(TreatmentHumanUse)   
## cond(TreatmentNatRegen)   
## cond(TreatmentSPP)   
## cond(low500\_sc)   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Relative variable importance:   
## cond(ActiveDays\_sc) cond(Treatment) cond(VegHt\_sc)  
## Importance: 1.00 0.53 0.53   
## N containing models: 3 2 2   
## cond(low500\_sc)  
## Importance: 0.19   
## N containing models: 1

## Length Class Mode   
## coefArray 72 -none- numeric

### Predictor Effect Sizes

## Warning: Removed 3 rows containing missing values (geom\_point).

## Warning: Removed 3 rows containing missing values (geom\_errorbar).

