Ch1\_models\_Wolf

Erin Tattersall

May 11, 2018

Based on model selection comparison of underlying distributions and zero-inflation, I chose an nbinom2 distribution for Wolf data, with zero-inflation and ActiveDays in the ZI model (see Ch1\_Wolf\_modelDistribution.Rmd)  
Here I will: 1. Double check random structure using all covariates 2. Build models with environmental covariates only  
3. Build hypothesis models with line covariates + environmental  
4. Perform model selection with AIC  
5. Calculate evidence ratios (AICwt of Best Model/ AICwt of other models)  
6. Checking residuals of Top Model 7. Model Averaging? 8. Standardize parameter estimates for easy interpretation  
Previous scale analysis showed lowland habitat and linear density measured at 1750m best explained Wolf detections

### 1. Random structure

Random structure was previously assessed, but here I will confirm using all model covariates

## Warning in fitTMB(TMBStruc): Model convergence problem; singular  
## convergence (7). See vignette('troubleshooting')

## dLogLik dAIC df weight  
## r2 45.8 0.0 14 0.946   
## rSite 41.9 5.7 13 0.054   
## rMonth 3.5 82.5 13 <0.001  
## r0 0.0 87.6 12 <0.001

## Environmental models

|  |  |
| --- | --- |
| Model Name | Covariates |
| E1 | None |
| E2 | low500 + pSnow |
| E3 | low500 |
| E4 | pSnow |

## dLogLik dAIC df weight  
## E4 2.3 0.0 7 0.425   
## E2 3.1 0.3 8 0.358   
## E1 0.0 2.5 6 0.120   
## E3 0.8 2.9 7 0.097

E4 and E2 have very similar model weights., with the pSnow only model coming out slightly on top. This may indicate that lowland is a ‘pretending variable’, or unrelated. Check deviance and parameter estimates for both models.

## Family: nbinom2 ( log )  
## Formula: Wolf ~ pSnow + (1 | Site) + (1 | Month)  
## Zero inflation: ~ActiveDays  
## Data: det  
##   
## AIC BIC logLik deviance df.resid   
## 1222.8 1258.1 -604.4 1208.8 1139   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## Site (Intercept) 1.6481 1.2838   
## Month (Intercept) 0.1551 0.3939   
## Number of obs: 1146, groups: Site, 60; Month, 12  
##   
## Overdispersion parameter for nbinom2 family (): 0.635   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -1.8021 0.2807 -6.42 1.36e-10 \*\*\*  
## pSnow -0.6868 0.2986 -2.30 0.0215 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Zero-inflation model:  
## Estimate Std. Error z value Pr(>|z|)  
## (Intercept) 13.660 18.301 0.746 0.455  
## ActiveDays -1.548 2.384 -0.649 0.516

## Family: nbinom2 ( log )  
## Formula: Wolf ~ low500 + pSnow + (1 | Site) + (1 | Month)  
## Zero inflation: ~ActiveDays  
## Data: det  
##   
## AIC BIC logLik deviance df.resid   
## 1223.1 1263.5 -603.6 1207.1 1138   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## Site (Intercept) 1.5536 1.2464   
## Month (Intercept) 0.1549 0.3936   
## Number of obs: 1146, groups: Site, 60; Month, 12  
##   
## Overdispersion parameter for nbinom2 family (): 0.634   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -0.9578 0.6937 -1.381 0.1674   
## low500 -1.2506 0.9581 -1.305 0.1918   
## pSnow -0.6927 0.2988 -2.318 0.0204 \*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Zero-inflation model:  
## Estimate Std. Error z value Pr(>|z|)  
## (Intercept) 14.441 24.152 0.598 0.550  
## ActiveDays -1.652 3.166 -0.522 0.602

Deviance does not change much, and lowland habitat does not seem to have a large effect on the response variable. Continue modelling Line characteristics with pSnow only, as this is the most parsimonious model

## Line characteristics

|  |  |
| --- | --- |
| Model Name | Covariates |
| L1 | Treatment + pSnow |
| L2 | VegHt + pSnow |
| L3 | LD1250 + pSnow |
| L4 | LineWidth + pSnow |
| L5 | Treatment + LineWidth + pSnow |
| L6 | LineWidth + VegHt + pSnow |
| L7 | Treatment + LD1250 + pSnow |
| L8 | LD1250 + VegHt + pSnow |
| L9 | Treatment + VegHt + pSnow |
| L10 | Treatment + LineWidth + VegHt + pSnow |
| L11 | Treatment + LineWidth + LD1250 + pSnow |
| L12 | Treatment + VegHt + LD1250 + pSnow |
| L13 | LineWidth + VegHt + LD1250 + pSnow |
| L14 | Treatment + LineWidth + LD1250 + VegHt + pSnow |

Six models within 2 dAIC points of each other, with model weights between 0.06 - 16%  
LineWidth present in 3, Treatment in 2, VegHt in 2

## 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 L4 4.3645019 0.0000000 0.16042438 0.1604244  
## 2 L9 7.0835110 0.5619818 0.12112605 0.2815504  
## 3 L5 7.0253873 0.6782292 0.11428646 0.3958369  
## 4 L2 3.6889928 1.3510180 0.08163953 0.4774764  
## 5 L6 4.4185350 1.8919338 0.06229342 0.5397698  
## 6 L1 5.3666192 1.9957653 0.05914192 0.5989118  
## 7 E4 2.2653158 2.1983720 0.05344412 0.6523559  
## 8 L12 7.2370387 2.2549263 0.05195404 0.7043099  
## 9 L10 7.2110013 2.3070012 0.05061875 0.7549287  
## 10 E2 3.0957064 2.5375909 0.04510654 0.8000352  
## 11 L11 7.0931372 2.5427292 0.04499080 0.8450260  
## 12 L8 3.8123586 3.1042866 0.03397685 0.8790029  
## 13 L7 5.5267634 3.6754769 0.02553587 0.9045387  
## 14 L13 4.4662529 3.7964980 0.02403650 0.9285752  
## 15 L3 2.4359171 3.8571695 0.02331829 0.9518935  
## 16 L14 7.3205299 4.0879439 0.02077708 0.9726706  
## 17 E1 0.0000000 4.7290037 0.01507927 0.9877499  
## 18 E3 0.7922151 5.1445735 0.01225012 1.0000000  
## EvidenceRatio  
## 1   
## 2 1.32444152198461  
## 3 1.40370418711178  
## 4 1.9650329525206  
## 5 2.57530220451798  
## 6 2.71253232124184  
## 7 3.00172167728598  
## 8 3.08781327434876  
## 9 3.16926781043981  
## 10 3.55656594476585  
## 11 3.56571507453421  
## 12 4.72157904909817  
## 13 6.28231432137754  
## 14 6.6741975609957  
## 15 6.87976664656356  
## 16 7.7212167609434  
## 17 10.6387379423948  
## 18 13.0957370259462

## Family: nbinom2 ( log )  
## Formula: Wolf ~ LineWidth + pSnow + (1 | Site) + (1 | Month)  
## Zero inflation: ~ActiveDays  
## Data: det  
##   
## AIC BIC logLik deviance df.resid   
## 1220.6 1260.8 -602.3 1204.6 1120   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## Site (Intercept) 1.5169 1.2316   
## Month (Intercept) 0.1565 0.3956   
## Number of obs: 1128, groups: Site, 59; Month, 12  
##   
## Overdispersion parameter for nbinom2 family (): 0.631   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -2.8216 0.9520 -2.964 0.00304 \*\*  
## LineWidth 0.1599 0.1361 1.175 0.24006   
## pSnow -0.6930 0.2994 -2.315 0.02064 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Zero-inflation model:  
## Estimate Std. Error z value Pr(>|z|)  
## (Intercept) 13.476 16.707 0.807 0.420  
## ActiveDays -1.522 2.169 -0.702 0.483

### Plotting residuals against fitted values and predicted values for all covariates

