Wild Basin Project

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Introduction

- Dr. Darren Proppe at St. Edward's University
- Wild Basin Wilderness Preserve (1974)
- Balcones Canyonlands Preserve System (1996)
- Increasing Population -> Increasing Highway Use and Development
- Golden-Cheeked Warbler (*Setophaga chrysoparia*)

Project Objective: Compare the Location of GCW Territories Throughout the BCP From 2011 – 2019 To Test Whether Territories Are Being Placed Further Away From Roadways and Development

Question: How do spatial trends change over time?


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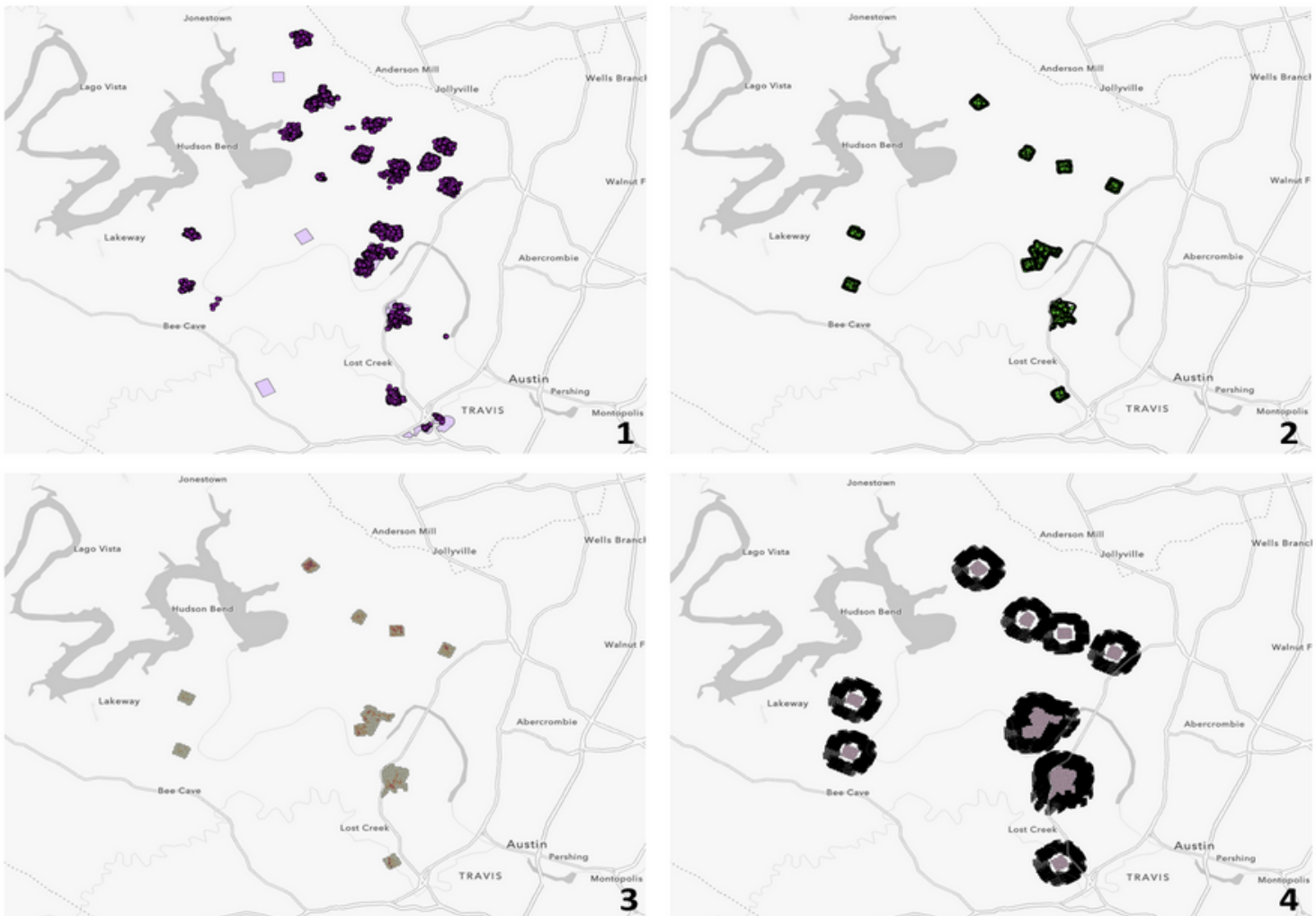
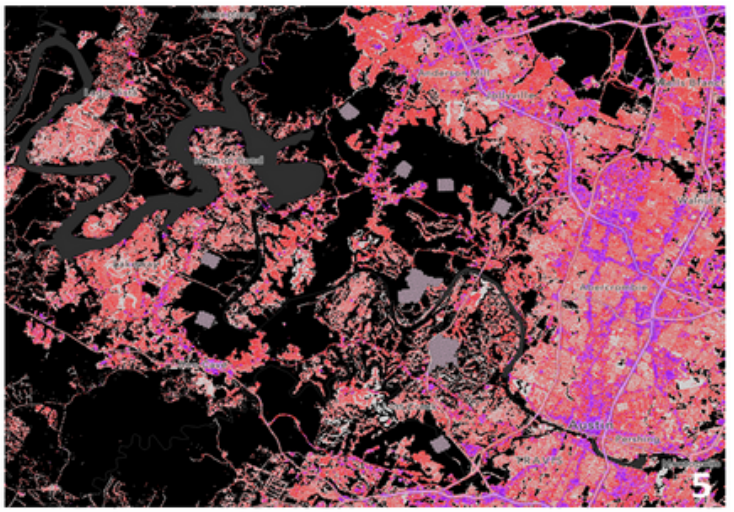
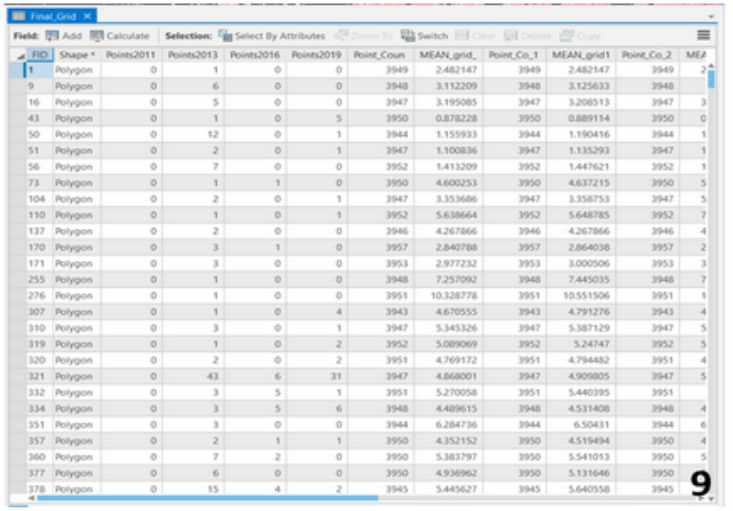
Data Tidying

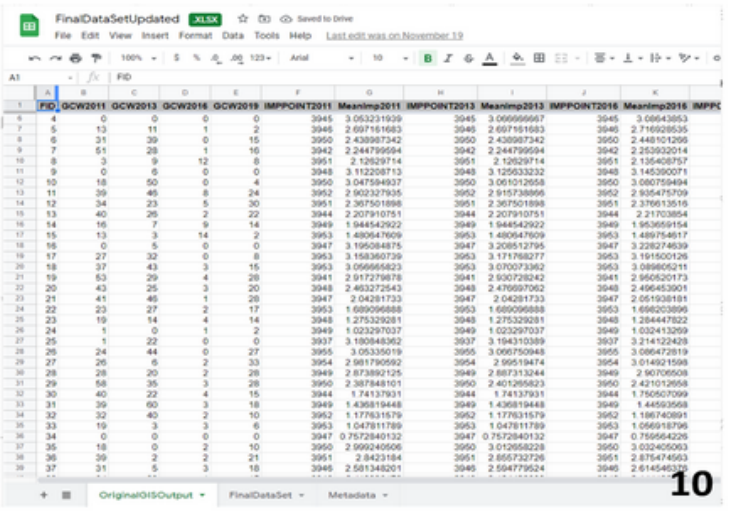


Data Tidying



Data Tidying





Data

Read the dataset:

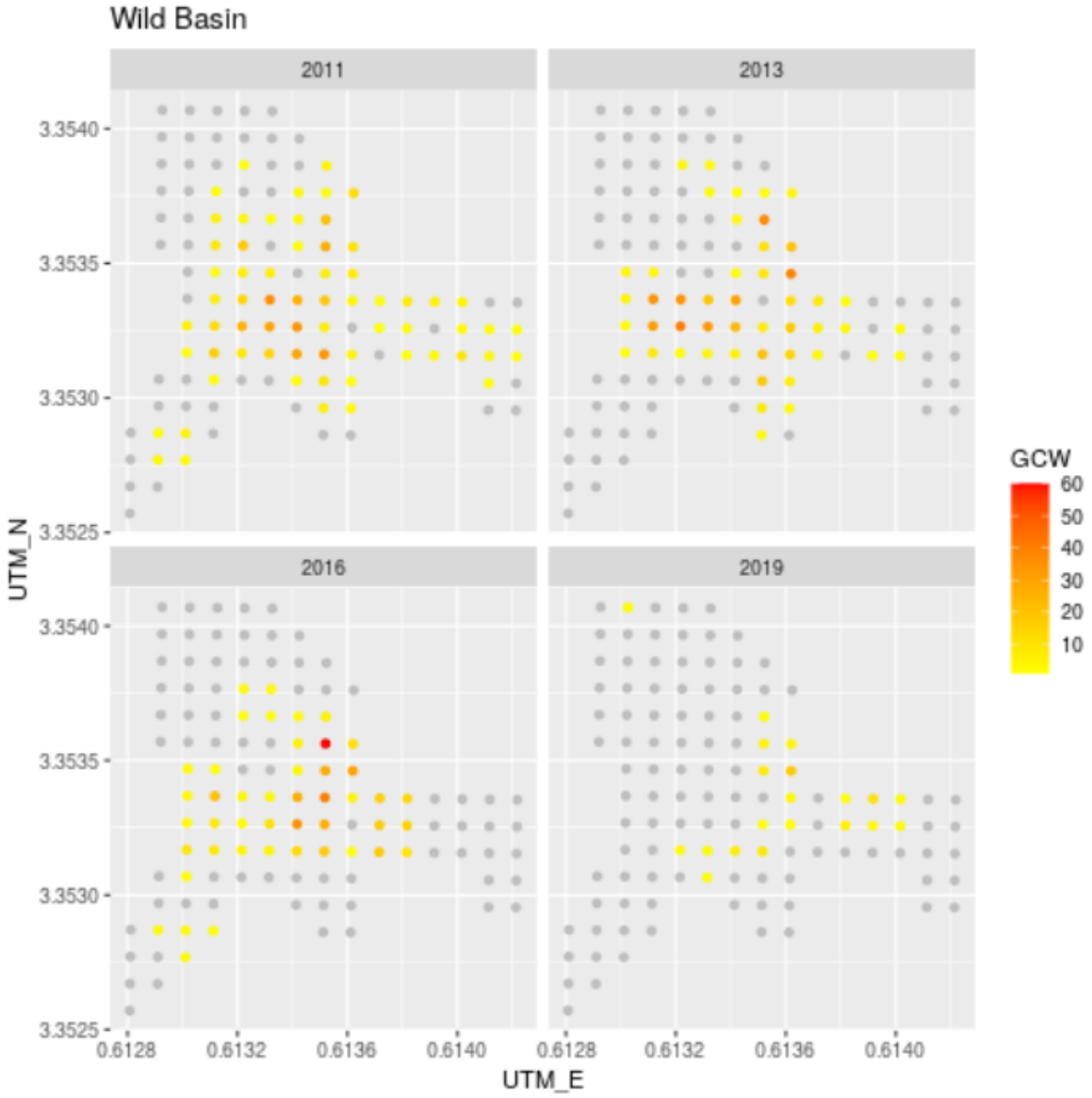
```
birds <- read.csv('https://docs.google.com/spreadsheets/d/e/2PACX-1v(
birds <- birds %>% mutate(
  Year = factor(Year),
  Property = factor(Property),
  # UTM_E and UTM_N are divided by 1,000,000 to reduce the scale
  UTM_E = UTM_E / 1000000,
  UTM_N = UTM_N / 1000000
)
birds %>% head(3)
```

```
##   GCW Year IMPCELLS  MeanImp CENTROID_X    CENTROID_Y     UTM_E    UTM_N
## 1   0 2011     3945 2.514322    3075385 10,133,459.51 0.6093014 3.368412
## 2   0 2011     3949 2.482147    3075057 10,133,131.43 0.6092002 3.368313
## 3  10 2011     3945 2.422053    3075385 10,133,131.43 0.6093002 3.368312
##      Property
## 1 Vista Point
## 2 Vista Point
## 3 Vista Point
```

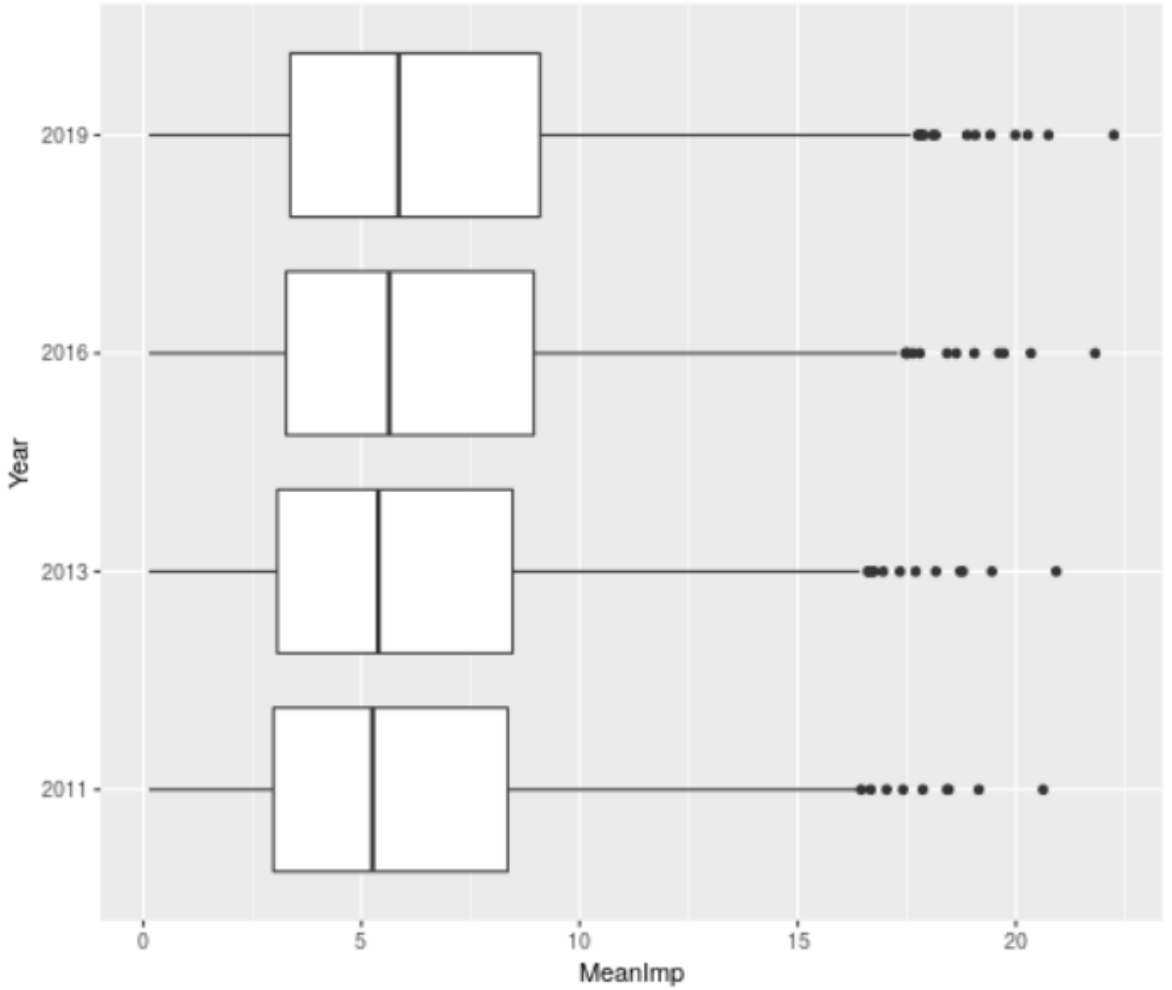
Variables

- **GCW**: Number of birds observed within a cell
- **Year**: Relevant year for each cell
- **IMPCELLS**: How many impervious raster cells there are within each grid cell buffer
- **MeanImp**: Mean percentage of impervious surface cover within each grid cell buffer
- **CENTROID_X**: Geographical x coordinate of the grid cell centroid
- **CENTROID_Y**: Geographical y coordinate of the grid cell centroid
- **UTM_E**: UTM Easting coordinate in meters divided by 1,000,000
- **UTM_N**: UTM Northing coordinate in meters divided by 1,000,000
- **Property**: Name of a property in which each grid cell is located

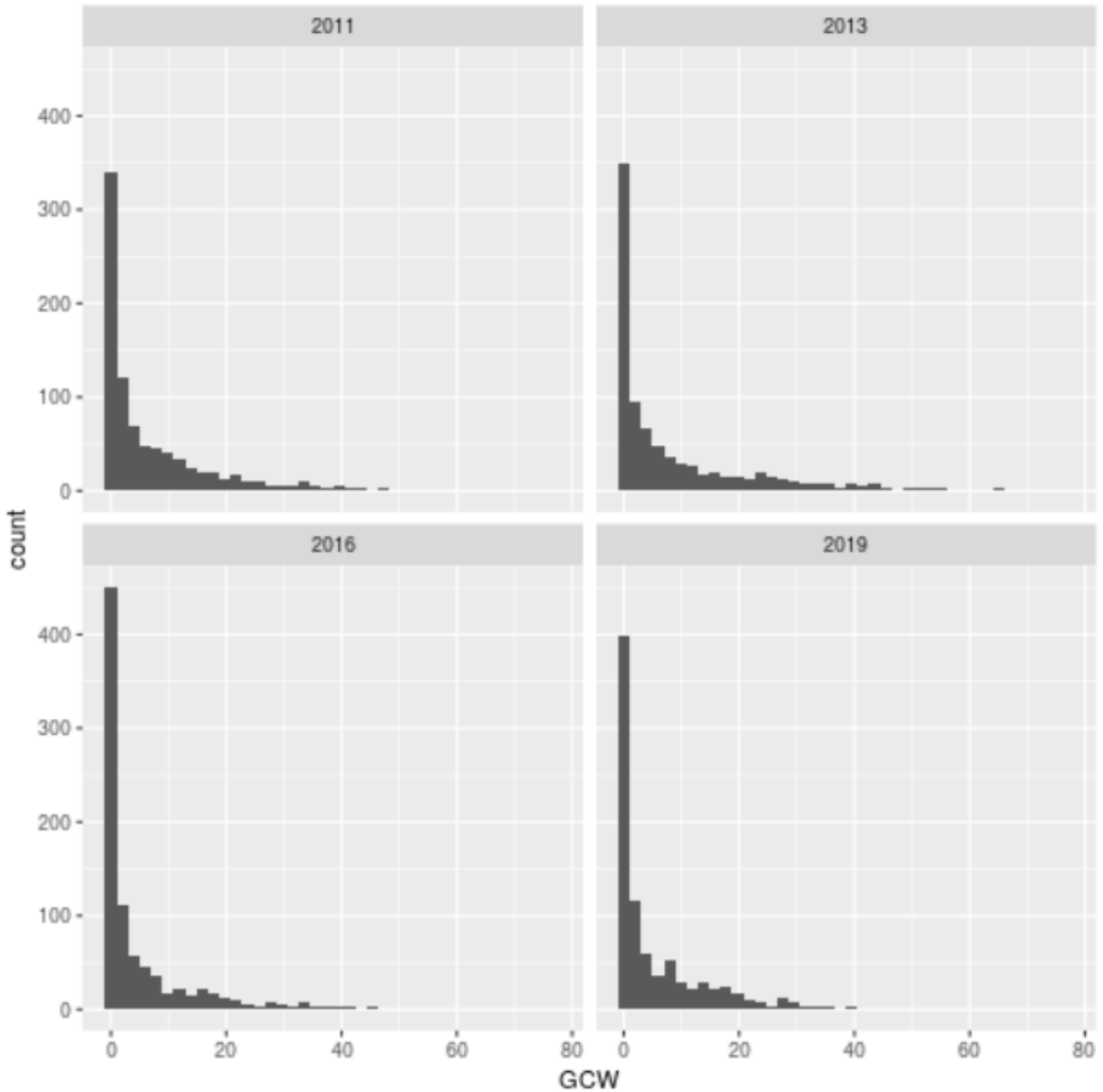
Data Visualization



Data Visualization



Data Visualization



Unsuccessful Model Fitting

Model Function

- Generalized Linear Mixed Model

Response Variable

- `GCW`

Predictor Variables

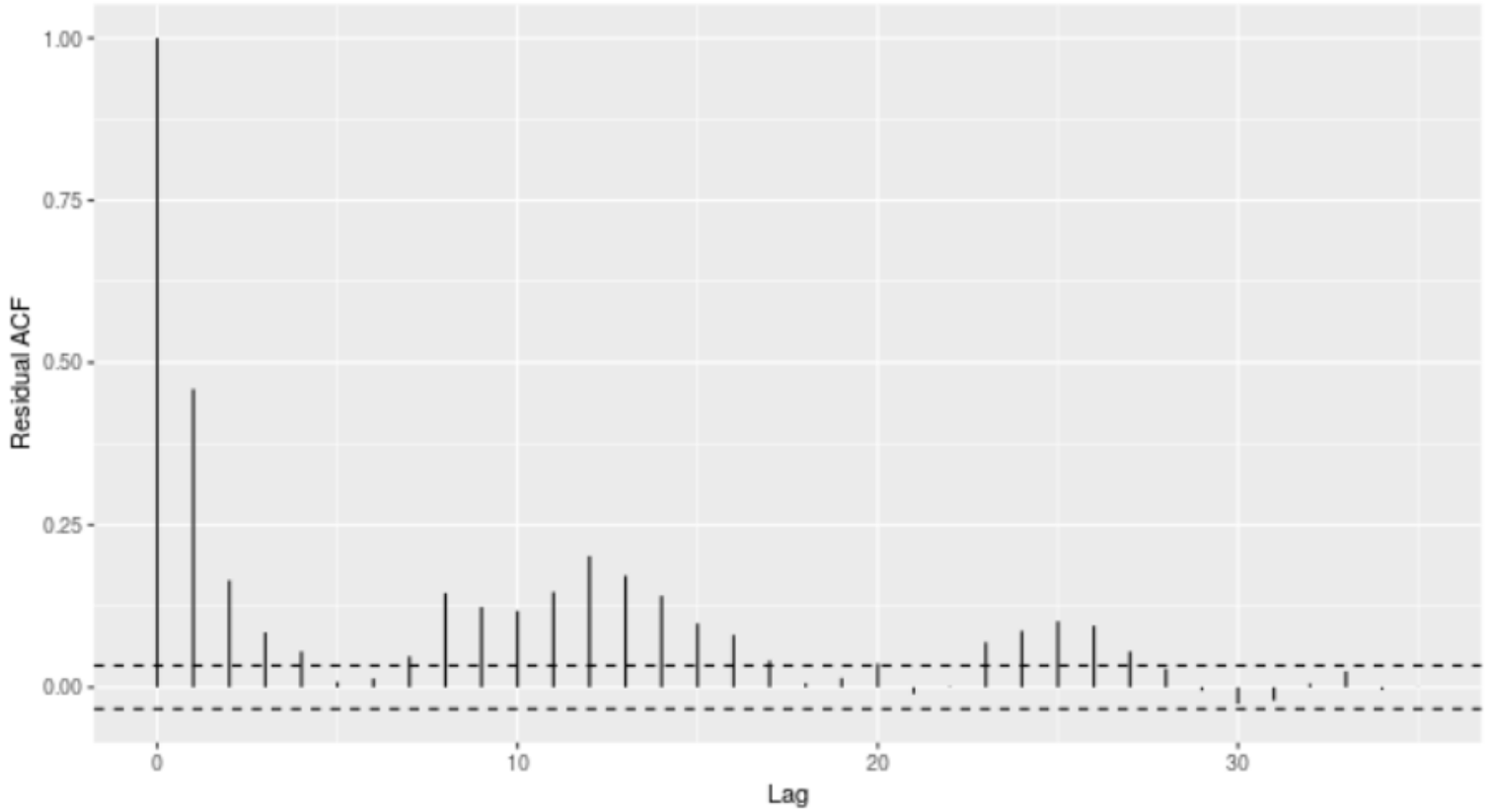
- `MeanImp`
- `UTM_N` and `UTM_E`
- `Year` (random effect)
- `Property` (random effect)

Unsuccessful Model Fitting

```
bird_nb <-
      glmmTMB(GCW ~ MeanImp + (1|Year) + (1|Property) +
                  UTM_N + UTM_E,
      family = nbinom1(link = 'log'),
      na.action = 'na.fail',
      data = birds)
```

Unsuccessful Model Condition

```
gf_acf(~bird_nb)
```



Successful Model Fitting

Model Function

- Generalized Additive Mixed Model

Response Variable

- `GCW`

Predictor Variables

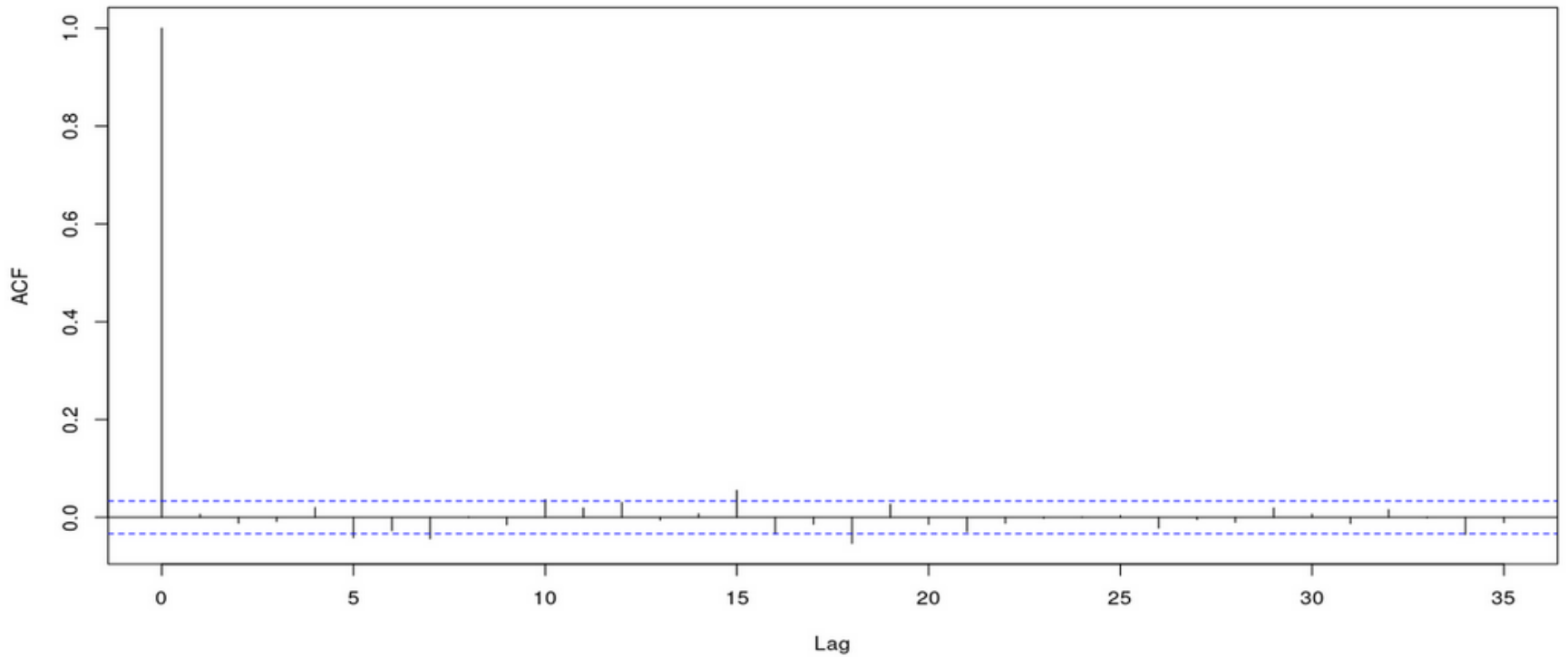
- `MeanImp` (smooth)
- `UTM_N` and `UTM_E` (smooth, spatial autocorrelation)
- `Year` (random effect)
- `Property` (random effect)

Successful Model Fitting

```
#bird_gam <- gamm(GCW ~ s(MeanImp, k = 10, bs = 'cs') +
#                       te(UTM_E, UTM_N, bs = 'ts', k = 11),
#                       random = list(Year = ~1, Property = ~1),
#                       correlation = corSpatial(
#                         form = ~ UTM_E + UTM_N, type='gaussian'),
#                       data = birds,
#                       method = "ML",
#                       family = negbin(theta = 0.6, link = 'log'))
```

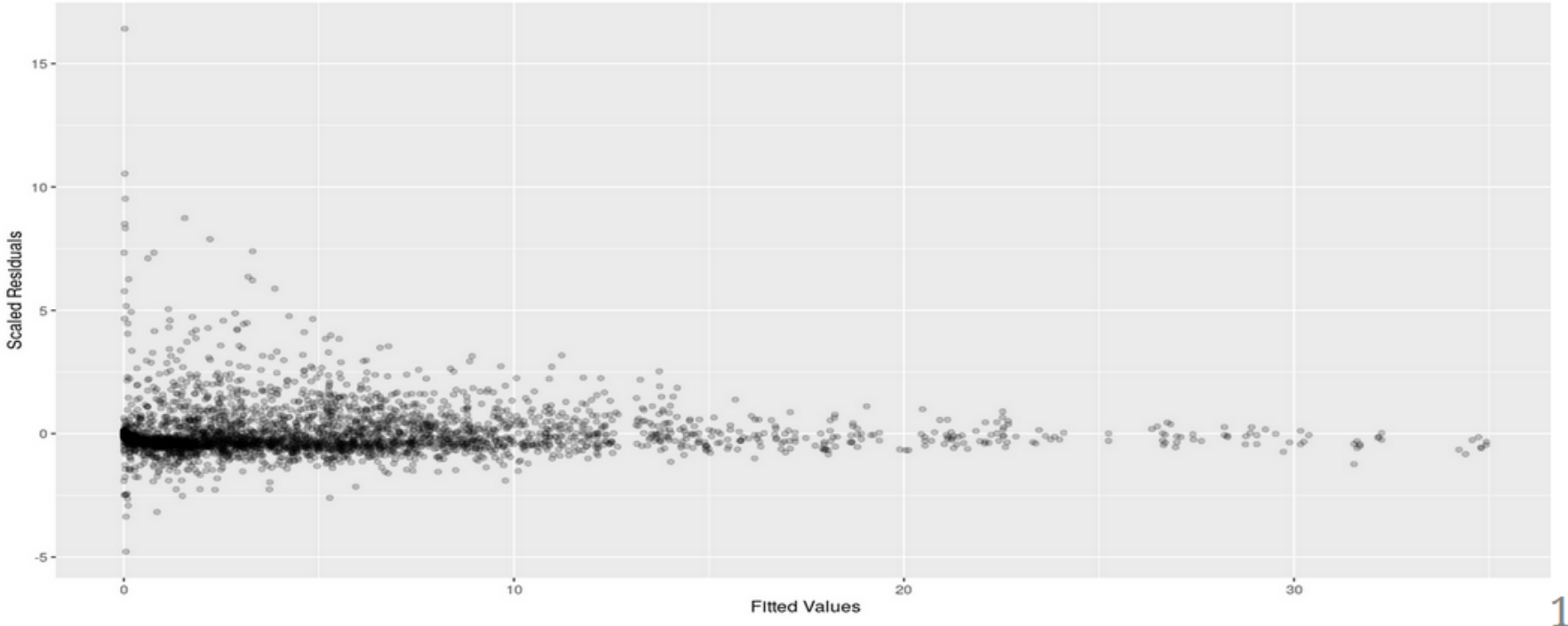
Successful Model Condition (ACF)

```
#res <- resid(bird_gam$lme, type = 'normalized') %>%
#  as.numeric()
#acf(res)
```



Successful Model Condition (Scaled Residuals)

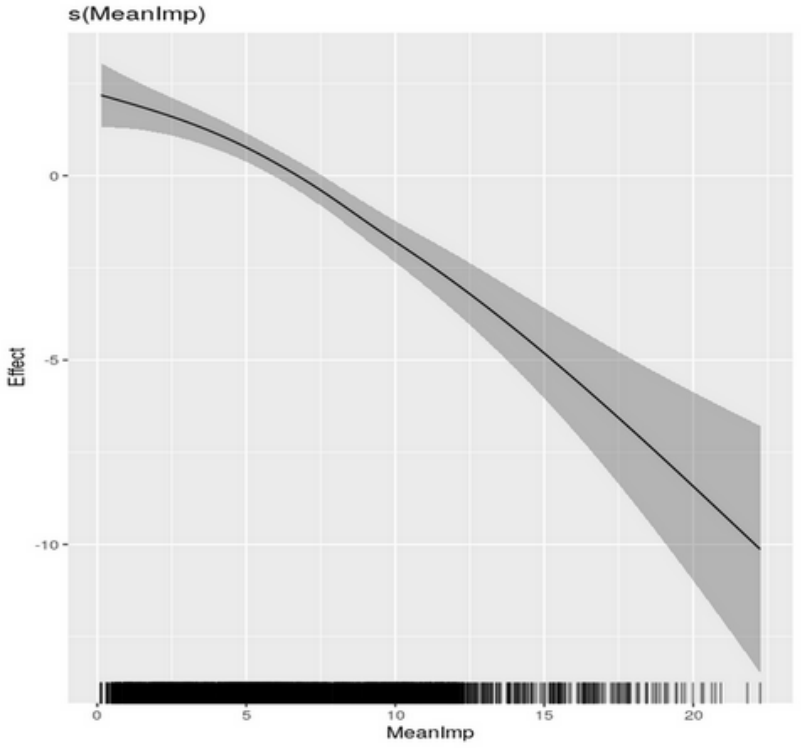
```
#fitted <- fitted(bird_gam$gam, type = 'normalized') %>%
#  as.numeric()

#gf_point(res ~ fitted, alpha = 0.2) %>%
#  gf_labs(x = 'Fitted Values', y = 'Scaled Residuals')
```

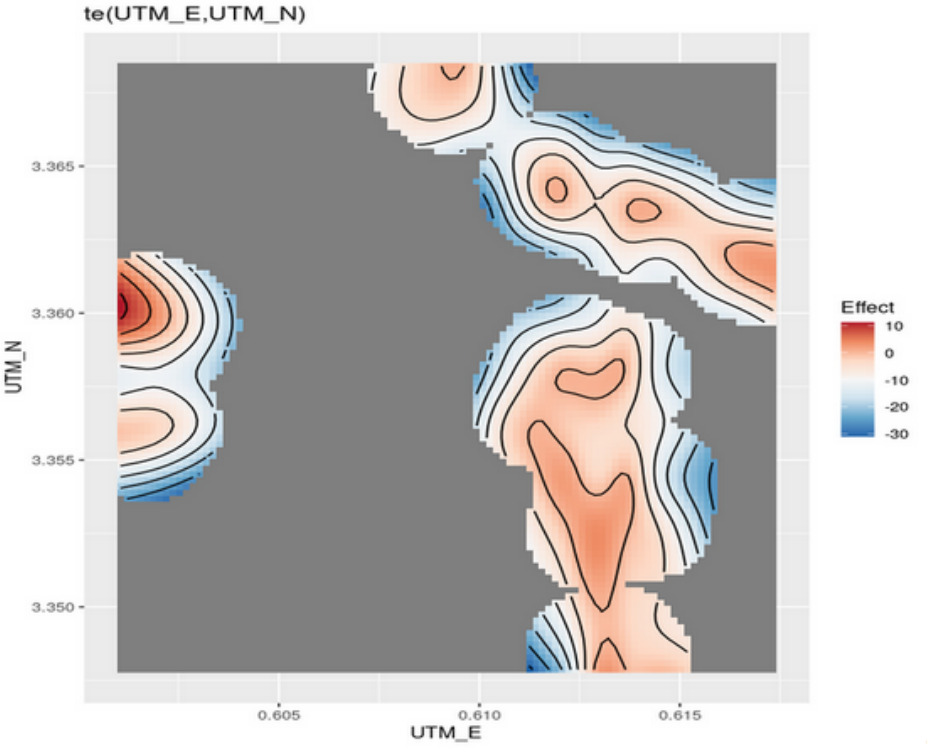


Model Graphics

- As MeanImp increases, the number of bird observations decreases almost linearly
- There is a difference of about 12 birds between areas with 0% and 20% impervious surface.

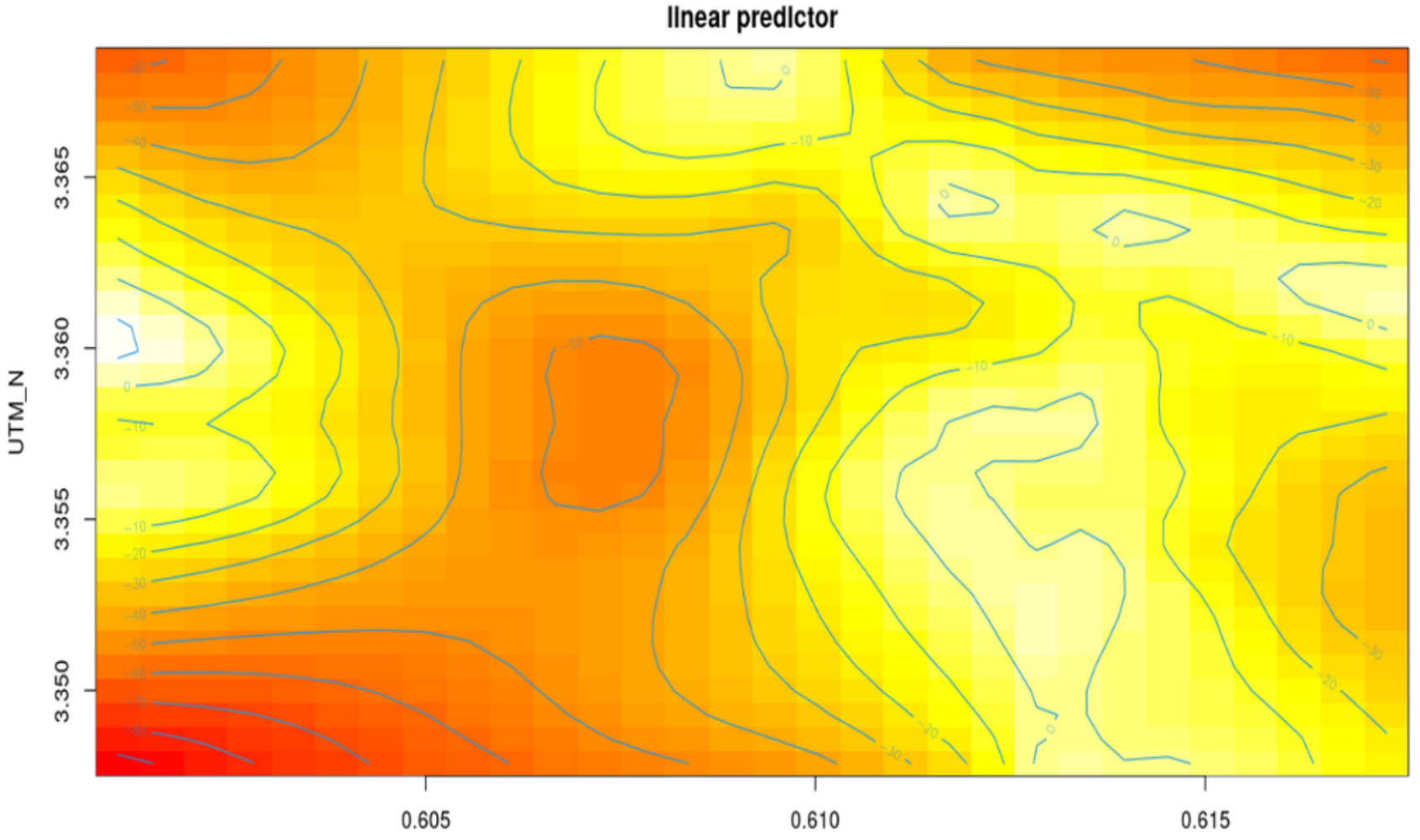
```
#draw(bird_gam$gam)
```





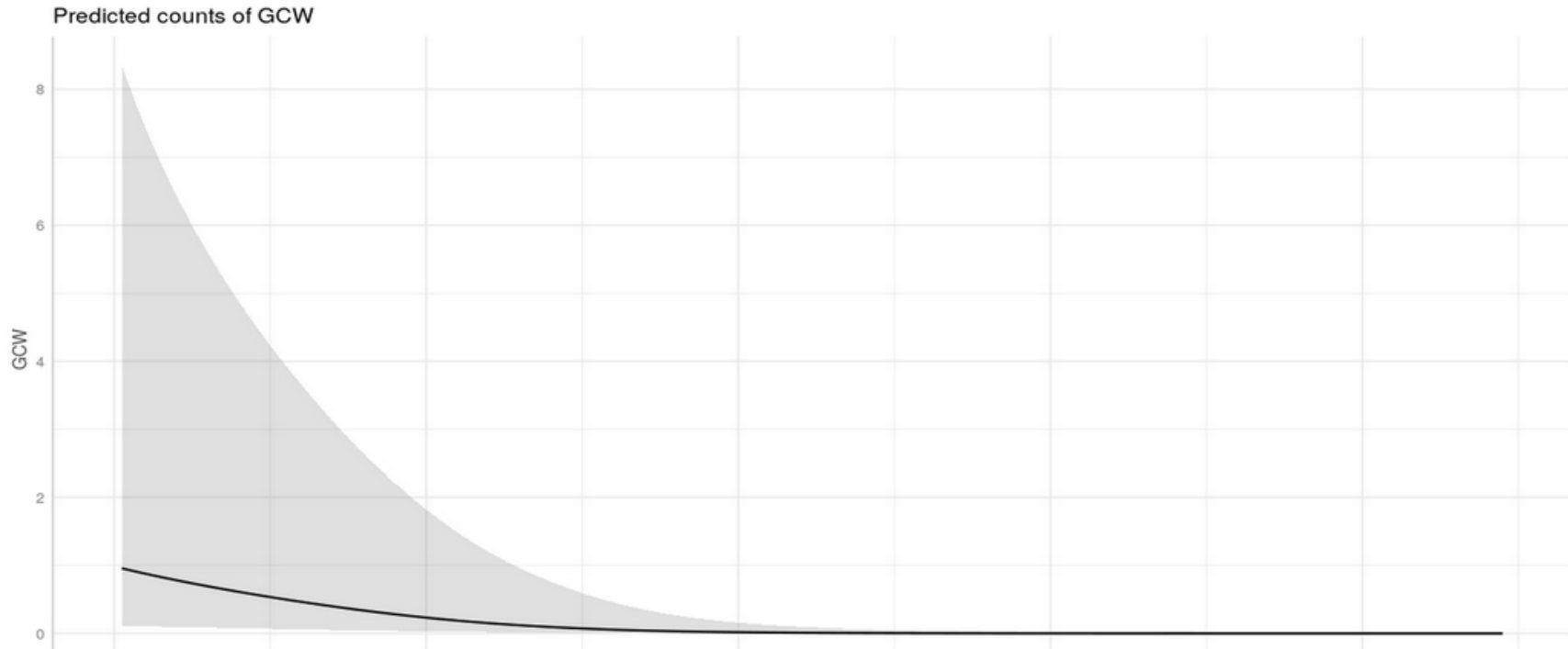
Model Graphics

```
#Contour of GCW ~ UTM_E + UTM_N
#vis.gam(bird_gam$gam, view = c("UTM_E", "UTM_N"), plot.type = "conto
```



Prediction Plot

```
#Prediction plot for GCW ~ MeanImp
#ggeffects::ggpredict(
  #bird_gam,
  #terms = c(
    #"MeanImp"),       #MeanImp is the only predictor varying
  #type = "fixed"  ) %>%

  #plot()
```



Summary

- The golden-cheeked warbler avoids areas with higher levels of impervious surface.
- Prediction line's y-intercept is at 1, goes down to 0 almost linearly.
- Confidence interval predicts up to 8 birds at 0% impervious surface, but drops exponentially.

Overview

- A lot of contents are related to GIS.
- Dr. Proppe was knowledgeable and experienced.
- Model function that we did not learn in class.
- Project visualization on the satellite image.
- Differentiate with roads and residential development.
- Dr. Proppe is going to present the findings

Questions:

1) What is specifically driving the golden-cheeked warbler movement (housing, roads, etc.)?

2) Are golden-cheeked warblers moving west away from development?