Evaluating differences between observers surveying for rails at night on ATVs

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Introduction

Rails are very difficult to detect, which makes surveying for them, and assessing the success of those surveys, very challenging. Rails are difficult to detect because they don't vocalize regularly in the fall, and do not respond to vocalizations, and their behavior has them dense in vegetation most of the time. They are also reluctant to flush out of the vegetation until you are very close to them. This is one of the reasons they are the least studied group of birds in North America and why there are no standard survey methods for them outside of the breeding season (Conway 2012).

My projects overall goals are to understand how different kinds of wetland management impact both rails and watefowl during their fall migration. A large part of my data collection is done by going out and surveying the locations of birds in a variety of different wetland impoundments. In 2013 and 2014 my project did double surveys each night, in which a wetland impoundment was surveyed two times, by two different people, in a short period of time (3 hours). These surveys are done from ATVs driving transects after sunset with a spotlight. Since rails are active during the day other then responding to our presence in the wetland we are assuming that they are sleeping or still the rest of the night. I did some preliminary telemetry work tracking rail's response to ATVs during the past two falls and have not detected one moving more then 10 meters in response to an ATV. As a result we hope that these two surveys on the same night are surveying the same birds in roughly the same locations. I wanted to use this point pattern analysis to examine the differences in marked point patterns from the same night. To do this I will look at the closest point between the two point patterns and examine the distribution of these distances and how they are arranged throughout the wetland impoundments.

Methods

I have a marked point patterns of observations of Sora (*Porzana carolina*) on 13 different public properties in 45 different wetland units across 6 months of surveys (3 months in each year). I will summarize the differences in pattern at the wetland level, as that is the unit of interest to my project as a whole and is the unit at which we consider the survey to be completed.

Across that time period we had four different observers (four in 2013 and two returning in 2014). For the purposes of this project we are just going to look at

2014, since there are only two observers so its simpler. If these patterns work for
two observers I will expand them to the four from 2013 in the future.

```
library(ggplot2)
library(rgdal)
library(gridExtra)
library(spatstat)
```

First I subsetted out the 2014 data and removed four of the sites because they
had very few observations and were creating very high distance values. Then I
re-projected it from lat/long to UTM.

```
setwd("C:/Users/avanderlaar/Documents/GitHub/data")
dat <- read.csv("all_birds.csv")
dat <- na.omit(dat)
dat <- dat[dat$species=="sora",]
## I am removing these three sites because they have very few points, and were causing most
dat <- dat[dat$canwr!="tmpca"&dat$canwr!="osca"&dat$canwr!="ccnwr"&dat$canwr!="tsca",]

## reprojecting the points into utm
utm <- as.data.frame(project(cbind(dat$long, dat$lat), "+proj=utm +zone=15 ellps=WGS84"))
colnames(utm) <- c("utm_w","utm_n")

dat <- cbind(dat, utm)
# taking only the 2014 points
dat4 <- dat[dat$year==2014,]

#figuring out how many unique survey days we have. jdate = julian date
jdate4 <- unique(dat4$jdate)
```

Then I created a list where each object in the list is a data frame of just the
observations from that day.

```
# creating list to put each days points into seperately.
list4 <- list()
## so this takes each day adn makes a list with each unique date being a level in the lsit
# removes days in which only one observer saw birds
for(i in 1:length(jdate4)){
  dat <- dat4[dat4$jdate==jdate4[i],]
  if (length(unique(dat$obs))>1){
  list4[[i]] <- dat}
}

##
```

Then I wrote a for loop to use the crossdist function from the spatstat package
to calculate the distance from each point to every other point in another set of
points, and vise versa. These are then rbind-ed together into one master dataset.

```r
dist4 <- list()
newdf <- list()

dista <- list()
newdfa <- list()
for (i in c(1:length(list4))){
  # takes one element out of the list and makes it a data frame
  df <- as.data.frame(list4[[i]])
  if (nrow(df)>1){
    # splits the points from one night into two point patterns, one for me (A) and one for N
    a <- df[df$obs=="N",]
    b <- df[df$obs=="A",]
    # figures out the distance between all the a points and the n points
    cdf <- crossdist(a$utm_w, a$utm_n, b$utm_w, b$utm_n)
    # finds the shortest distance for each point (row)
    c <- apply(cdf, 1, min)
    #figures out the distance between all the n points and the a points
    cdf2 <- crossdist(b$utm_w, b$utm_n, a$utm_w, a$utm_n)
    # finds the shortest distance for each point (row)
    d <- apply(cdf2, 1, min)
    # cbinding together the distances with their respective points, then stacking the points
    newdfa[[i]] <- rbind(cbind(a, dist=c),cbind(b,dist=d))
  }
  }

# binding together all the objects from the above for loop
dist <- do.call(rbind, newdfa)
# cutting out the outliers (those over 1000 meters, which are all instances where the neares
dist <- dist[dist$dist<=1000,]

dist$scale <- as.numeric(scale(dist$dist))


{r, warning=FALSE, echo=FALSE, message=FALSE, results="hide"} ##
reading in the outlines of the units we surveyed nv <- readOGR(dsn="C:/Users/avanderlaar/Dro
layer="nv_impound") #nv <- spTransform(nv, CRS("+proj=utm +zone=15
ellps=WGS84")) nv$ID <- seq(1:5) nv <- nv[nv$ID != 4 & nv$ID !=
3,] sc <- readOGR(dsn="C:/Users/avanderlaar/Dropbox/GIS/2014",
layer="sc_impound") sc <- spTransform(sc,CRS("+proj=utm +zone=15
ellps=WGS84")) sc <- sc[sc$NAME=="MSU 3"|sc$NAME=="MSU 2"|sc$NAME=="Snow
Goose B"|sc$NAME=="Snow Goose D",] sl <- readOGR(dsn="C:/Users/avanderlaar/Dropbox/GIS/2014'
layer="sl_impound") sl <- spTransform(sl, CRS("+proj=utm +zone=15
```

```
ellps=WGS84")) sl <- sl[sl$Id==3|sl$Id==4|sl$Id==5,] fg <- readOGR(dsn="C:/Users/avanderlaar
layer="fg_impound") fg <- spTransform(fg, CRS("+proj=utm +zone=15
ellps=WGS84")) fg <- fg[fg$pool_name=="GRWI 3"|fg$pool_name=="Pool
2"|fg$pool_name=="GRWI 2",] ts <- readOGR(dsn="C:/Users/avanderlaar/Dropbox/GIS/2014",
layer="ts_impound") ts <- spTransform(ts,CRS("+proj=utm +zone=15
ellps=WGS84")) ts <- ts[ts$pool_name=="1A-3A"|ts$pool_name=="6A"|ts$pool_name=="8A"|ts$pool_
bkkl9 <- readOGR(dsn="C:/Users/avanderlaar/Dropbox/GIS/2014",
layer="bk_impound9") bkkl9 <- spTransform(bkkl9, CRS("+proj=utm
+zone=15 ellps=WGS84")) bkkl5 <- readOGR(dsn="C:/Users/avanderlaar/Dropbox/GIS/2014",
layer="bk_impound5") bkkl5 <- spTransform(bkkl5, CRS("+proj=utm
+zone=15 ellps=WGS84")) bkkl6 <- readOGR(dsn="C:/Users/avanderlaar/Dropbox/GIS/2014",
layer="bk_impound6") bkkl6 <- spTransform(bkkl6, CRS("+proj=utm
+zone=15 ellps=WGS84")) bkkl2 <- readOGR(dsn="C:/Users/avanderlaar/Dropbox/GIS/2014",
layer="bk_impound2") bkkl2 <- spTransform(bkkl2, CRS("+proj=utm
+zone=15 ellps=WGS84")) dc <- readOGR(dsn="C:/Users/avanderlaar/Dropbox/GIS/2014",
layer="dc_impound") dc <- spTransform(dc, CRS("+proj=utm +zone=15
ellps=WGS84")) dc <- dc[dc$Id == 18 | dc$Id == 20|dc$Id ==22|dc$Id
==14,]
```

"'{r, echo=FALSE, message=FALSE, warning=FALSE, fig.height=10} # plots
plots plots library(ggmap) latlong <- read.csv("~/GitHub/stats_spring_2015/ggmap_coords.csv")

nvca <- get_map(location=c(latlong[latlong$area=="nvca",]$long, latlong[latlong$area=="nvca",]$lat), zoom = 14, maptype = "satellite")scnwr <- get_map(location = c(latlong[latlong$area=="scnwr",]$long, latlong[latlong$area=="scnwr"]... 14, maptype = "satellite")fgca <- get_map(location = c(latlong[latlong$area=="fgca",]$long, latlong[latlong$area=="fgca"]... 14, maptype = "satellite")slnwr <- get_map(location = c(latlong[latlong$area=="slnwr",]$long, latlong[latlong$area=="slnwr"]... 14, maptype = "satellite")bkca <- get_map(location = c(latlong[latlong$area=="bkca",]$long, latlong[latlong$area=="bkca"]... 14, maptype = "satellite")dcca <- get_map(location = c(latlong[latlong$area=="dcca",]$long, latlong[latlong$area=="dcca"]... zoom=14,maptype="satellite")

ggmap(nvca)+ geom_point(data=dist[dist$canwr=="nvca",],aes(x=long, y=lat,
colour=dist))+ #geom_polygon(data=nv, aes(x=long,y=lat, group=group),
fill=NA, colour="black")+ ggtitle("nvca - Nodaway Valley Conservation Area")
ggmap(scnwr)+ geom_point(data=dist[dist$canwr=="scnwr",],aes(x=long,
y=lat, colour=dist))+ #geom_polygon(data=sc, aes(x=long,y=lat,
group=group), fill=NA, colour="black")+ ggtitle("scnwr - Squaw Creek National
Wildlife Refuge") ggmap(fgca)+ geom_point(data=dist[dist$canwr=="fgca",],aes(x=long,
y=lat, colour=dist))+ #geom_polygon(data=fg, aes(x=long,y=lat,
group=group), fill=NA, colour="black")+ ggtitle("fgca - Fountain Grove Conser-
vation Area") ggmap(slnwr)+ geom_point(data=dist[dist$canwr=="slnwr",],aes(x=long,
y=lat, colour=dist))+ #geom_polygon(data=sl, aes(x=long,y=lat,
group=group), fill=NA, colour="black")+ ggtitle("slnwr - Swan Lake National
Wildlife Refuge") ggmap(bkca)+ geom_point(data=dist[dist$canwr=="bkca",],aes(x=long,
y=lat, colour=dist))+ #geom_polygon(data=bkkl9, aes(x=long,y=lat,
group=group), fill=NA, colour="black")+ #geom_polygon(data=bkkl2,
aes(x=long,y=lat, group=group), fill=NA, colour="black")+ #geom_polygon(data=bkkl5,
aes(x=long,y=lat, group=group), fill=NA, colour="black")+ #geom_polygon(data=bkkl6,

aes(x=long,y=lat, group=group), fill=NA, colour="black")+ ggtitle("bkca - BK Leach Conservation Area") ggmap(dcca)+ geom_point(data=dist[dist$canwr=="dcca",],aes(x=long, y=lat, colour=dist))+ #geom_polygon(data=dc, aes(x=long,y=lat, group=group), fill=NA, colour="black")+ ggtitle("dcca - Duck Creek Conservation Area")

""

"'{r, fig.height=10} ggplot()+ geom_histogram(data=dist, aes(x=dist), binwidth=10)+ facet_grid(canwr ~ .)

ggplot()+ geom_histogram(data=dist, aes(x=scale), binwidth=0.01)+ facet_grid(canwr ~ .)

model <- lm(data=dist, scale ~ canwr)

uni <- unique(dist$canwr)

canwr <- list()

for(i in 1:6){ canwr[[i]] <- dist[dist$canwr==uni[i],] }

library(BSDA)

z <- list()

for(i in 1:6){ df <- canwr[[i]] z[[i]] <- z.test(df$scale, mu=0, sigma.x=1) }

z

""

So something weird is happening at Swan Lake NWR (slnwr) but the rest seem... vaguely normally distributed.

```
model <- lm(data=dist, dist ~ canwr)
summary(model)
```

Discussion

In 2013 and 2014 we put out radio transmitters on rails and tracked them in response to the ATVs. We never observed a rail moving more then 10 meters from its original location in response to an ATV. Based on our efforts catching rails at night we know that once they fly/or run from an ATV they typical stop and stay where they end up. At night they are sleeping, so they likely return to sleeping after we disturb them. Based on this I do not think they are actively moving around the impoundment during the night, at least not large distances.

Based on the model outputs from the distance sampling based surveys that we do (that generated these point patterns) detection probability for a Sora is low

~30%. So the fact that most of these points don't have a close (<50m) neighbor isn't surprising.

What I find most intriguing is that on some properties the farther distance points are clustered, which based on my knowledge of the area makes sense, since most of them are in areas with very thick/tall vegetation that makes detection very difficult, so detection probability is probably lower there.

I'm not sure expanding this project to 2013 is worth examining since this has reinforced my ideas that detection is low, but does prompt thinking about how we should be thinking about repeat surveys

References