

cameraTrapAnalysis.R

Sam

Wed Mar 15 15:44:25 2017

```
# Data analysis for Williams, S.T., Williams, K.S., Lewis, B.P. and Hill, R.A. (2017) Population dynam
```

```
# Code prepared by Sam Williams (samual.t.williams@gmail.com)
```

```
#####
```

```
### Figures
```

```
#####
```

```
rm(list=ls())
```

```
library(dplyr)
```

```
##
```

```
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
```

```
##
```

```
## filter, lag
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
## intersect, setdiff, setequal, union
```

```
library(ggplot2)
```

```
library(extrafont)
```

```
## Registering fonts with R
```

```
library(scales)
```

```
# Figure 2. Sampling periods in which individual leopards were photographed on camera traps in the Sout
```

```
heatmapDF <- read.csv("heatmapLeopard.csv")
```

```
p <- ggplot(heatmapDF, aes(x=period, y=leopardID, fill=asc)) +
```

```
  scale_y_discrete(limits=c("SA21", "SA20", "SA19", "SA18", "SA17", "AF28", "AF27", "AM16", "AM15", "SA16"
```

```
p <- p + geom_tile() +
```

```
  labs(x="Sampling period", y="Individual") +
```

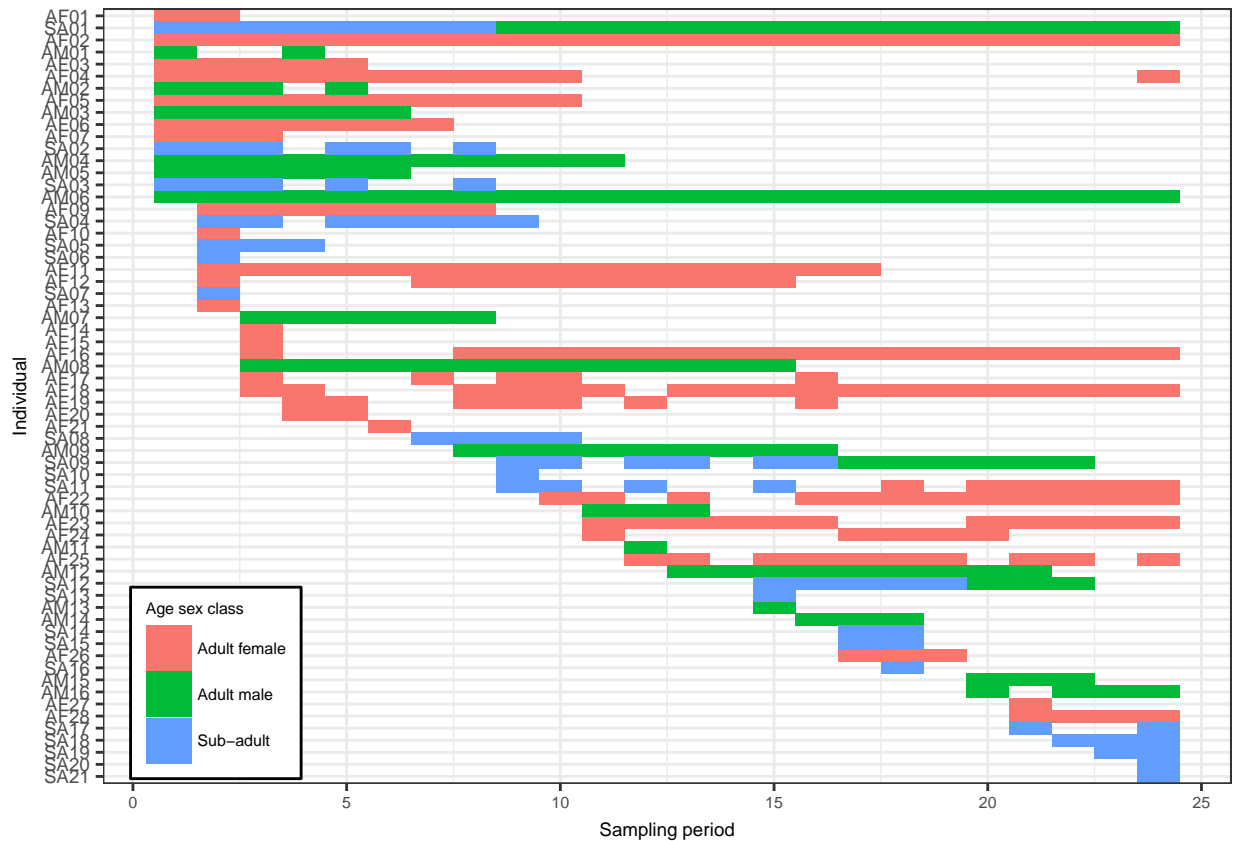
```
  theme_bw() +
```

```
  theme(text=element_text(family="Helvetica", size=7), legend.position=c(.1,.13), legend.backgroun
```

```
  guides(fill=guide_legend(title="Age sex class")) #+
```

```
p
```

```
## Warning: Removed 1 rows containing missing values (geom_tile).
```



```
ggsave("Fig. 2.pdf", width=190, height=150, units="mm")
```

```
## Warning: Removed 1 rows containing missing values (geom_tile).
```

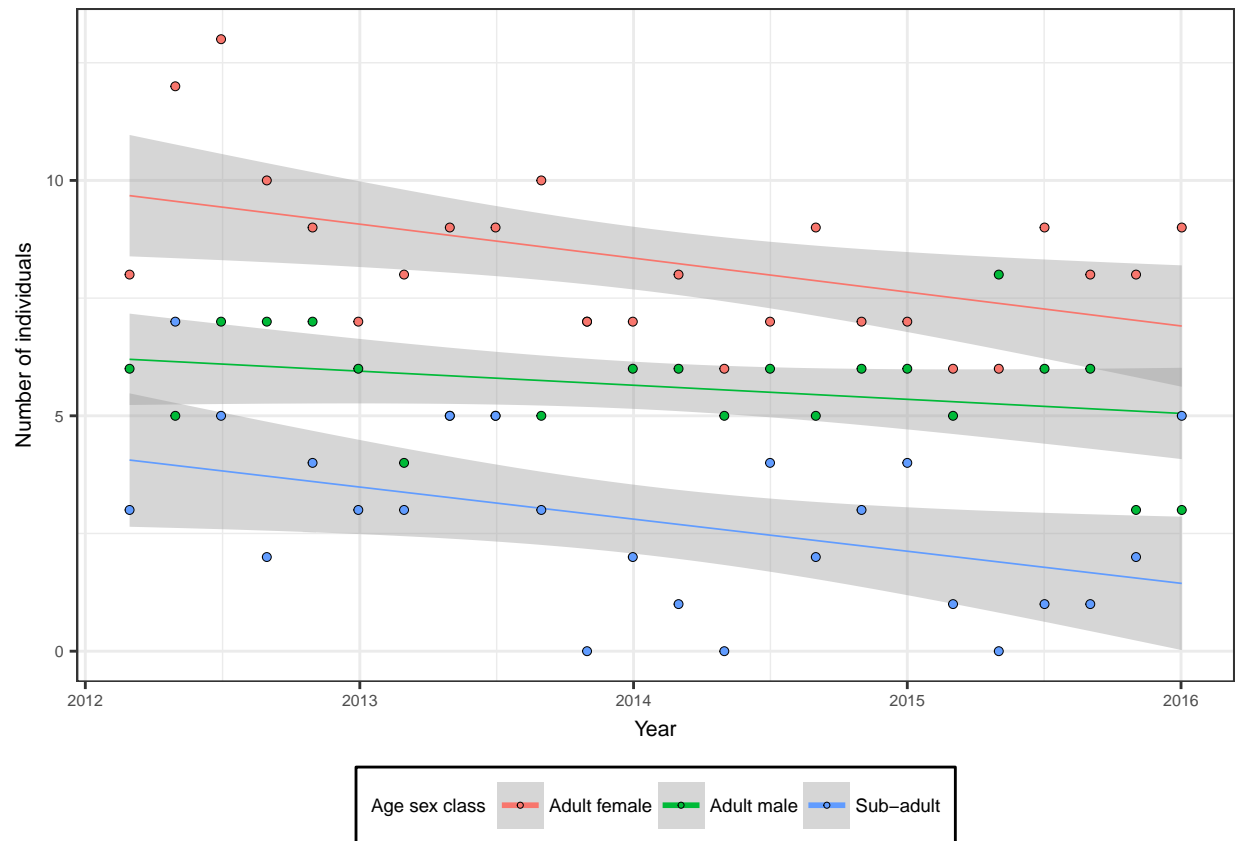
```
###
```

Figure 3. Change in number of individual leopards identified per sampling period in each age sex class

```
individuals <- read.csv("individuals.csv")
individualsNoTotal <- filter(individuals, excludeTotal=="Yes")
individualsNoTotal$date <- as.Date(individualsNoTotal$date)

p <- ggplot(individualsNoTotal, aes(x=date, y=numberOfIndividuals, shape=asc)) +
  geom_smooth(method = lm, aes(colour=asc), size=0.3) +
  geom_point(aes(fill=asc,
                  colour="black", pch=21, size=1.5, stroke=0.1, alpha=1)) +
  theme_bw() +
  labs(x = "Year", y = "Number of individuals", colour="Age sex class", fill="Age sex class") +
  theme(text=element_text(family="Helvetica", size=8), legend.background = NULL, legend.text=element_text(family="Helvetica", size=8)) +
  guides(colour = guide_legend(override.aes = list(size=1))) +
  scale_linetype_discrete(name="Age sex class ")
```

p



```
ggsave("Fig. 3.pdf", width=90, height=80, units="mm")
```

```
###
```

Figure 4. Change in the population density of leopards in the Soutpansberg Mountains between 2008 and

```
mydf <- read.csv("densityInclExcl2008.csv") # reads in data
```

```
mydf$date <- as.Date(mydf$date) # Formats date properly
```

```
dateVec<-seq(from=as.Date("2008-05-01"), to=as.Date("2016-03-01"), by="days")
```

```
p <- ggplot(mydf, aes(x=date, y=density)) +
```

```
  # geom_errorbar(aes(ymax = mydf$upperHPD, ymin=mydf$lowerHPD), width=30, size=0.2, colour="grey")
```

```
  geom_smooth(method = lm, se=TRUE, size=0.3, aes(colour=InclExcl)) +
```

```
  geom_point(size=0.5, aes(colour=InclExcl)) +
```

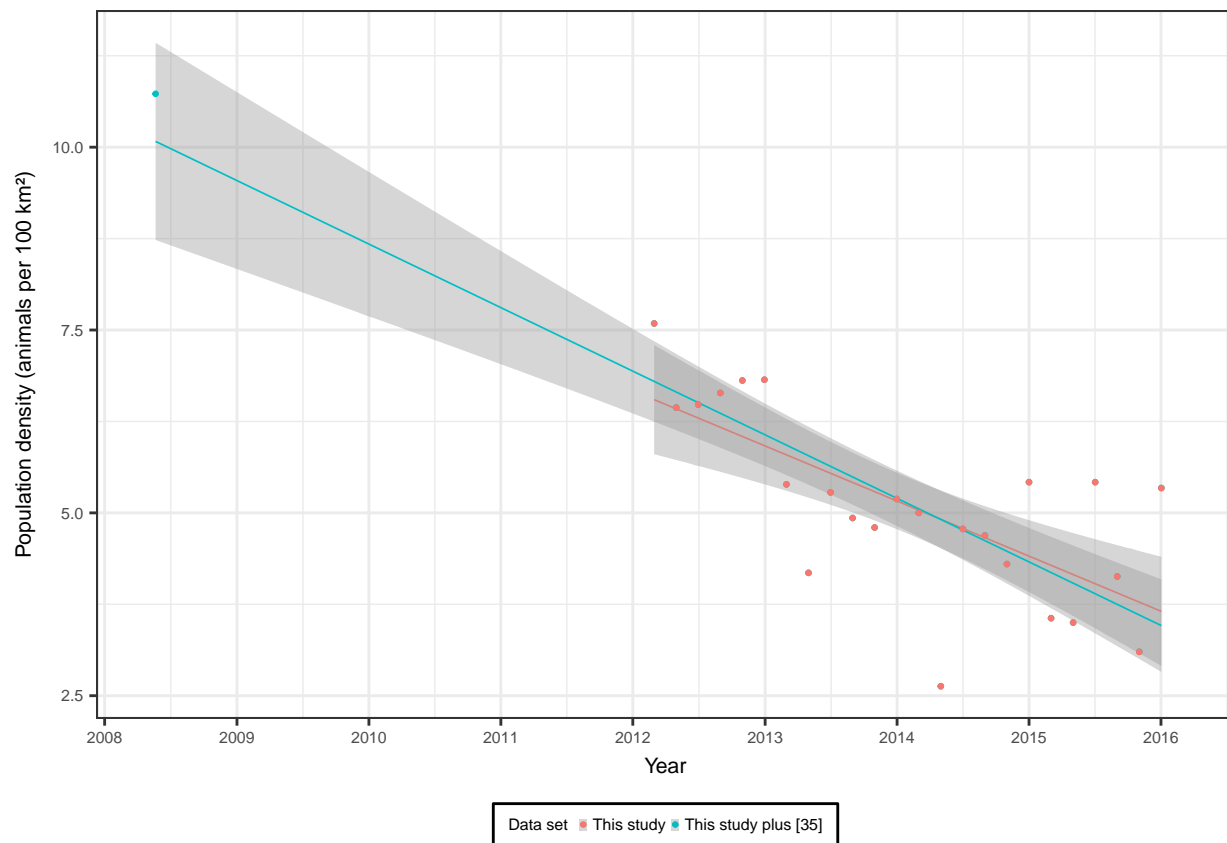
```
  labs(x = "Year", y = "Population density (animals per 100 km²)", colour="Data set") +
```

```
  theme_bw() +
```

```
  theme(text=element_text(family="Helvetica", size=8), legend.position="bottom", legend.background="white",
```

```
  scale_x_date(labels = date_format("%Y"), limits=c(min(dateVec), max=max(dateVec)), date_breaks = "1 year")
```

```
p
```



```
ggsave("Fig. 4.pdf", width=90, height=80, units="mm")
```

```
#####
```

```
#####
# Analysis
#####
```

```
# Test for difference in the number of sampling periods for which adult males and adult females remaine
```

```
tenure <- read.csv("leopardTenure.csv")
```

```
wilcox.test(tenure ~ asc, data = tenure, paired = FALSE, exact = FALSE)
```

```
##
```

```
## Wilcoxon rank sum test with continuity correction
```

```
##
```

```
## data: tenure by asc
```

```
## W = 276.5, p-value = 0.5276
```

```
## alternative hypothesis: true location shift is not equal to 0
```

```
###
```

```
# Linear regression of date against number of individuals of each age sex class per sampling period
```

```
individuals <- read.csv("individuals.csv")
```

```

individuals$date <- as.Date(individuals$date)

# linear regression adult males against date
# Import data
individualsAM <- filter(individuals, asc=="Adult male")
modelAM <- lm(numberOfIndividuals ~ date, data = individualsAM)
summary(modelAM)

##
## Call:
## lm(formula = numberOfIndividuals ~ date, data = individualsAM)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.1000 -0.7625  0.2000  0.8125  2.7500
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 18.8221311  9.2049436   2.045   0.053 .
## date        -0.0008197  0.0005715  -1.434   0.166
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.182 on 22 degrees of freedom
## Multiple R-squared:  0.0855, Adjusted R-squared:  0.04393
## F-statistic: 2.057 on 1 and 22 DF,  p-value: 0.1656

# linear regression of number of adult females against date
individualsAF <- filter(individuals, asc=="Adult female")
modelAF <- lm(numberOfIndividuals ~ date, data = individualsAF)
summary(modelAF)

##
## Call:
## lm(formula = numberOfIndividuals ~ date, data = individualsAF)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.1110 -1.3610 -0.2132  1.0121  3.5642
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 40.0795391 12.2295634   3.277  0.00344 **
## date        -0.0019743  0.0007593  -2.600  0.01634 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.571 on 22 degrees of freedom
## Multiple R-squared:  0.2351, Adjusted R-squared:  0.2003
## F-statistic: 6.761 on 1 and 22 DF,  p-value: 0.01634

# Linear regression of number of sub-adults against date
individualsCub <- filter(individuals, asc=="Sub-adult")
modelCub <- lm(numberOfIndividuals ~ date, data = individualsCub)

```

```
summary(modelCub)
```

```
##
## Call:
## lm(formula = numberOfIndividuals ~ date, data = individualsCub)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.9209 -1.0222 -0.3639  1.2596  3.5600
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 32.8165075 13.4423637   2.441  0.0231 *
## date        -0.0018674  0.0008346  -2.237  0.0357 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.726 on 22 degrees of freedom
## Multiple R-squared:  0.1854, Adjusted R-squared:  0.1483
## F-statistic: 5.006 on 1 and 22 DF,  p-value: 0.03571
# Linear regression of total individuals against date
individualsTotal <- filter(individuals, asc=="Total")
modelTotal <- lm(numberOfIndividuals ~ date, data = individualsTotal)
summary(modelTotal)
```

```
##
## Call:
## lm(formula = numberOfIndividuals ~ date, data = individualsTotal)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -5.2401 -1.9854  0.4707  1.2351  5.6320
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 91.718178  20.623109   4.447 0.000202 ***
## date        -0.004661   0.001280  -3.640 0.001444 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.649 on 22 degrees of freedom
## Multiple R-squared:  0.3759, Adjusted R-squared:  0.3476
## F-statistic: 13.25 on 1 and 22 DF,  p-value: 0.001444
###
```

```
# Linear regression of density against date
# Import data
densityData <- read.csv("densityInclExcl2008.csv")
densityData$date <- as.Date(densityData$date)

# Linear regression of density against date excluding 2008 estimate
densityExcl2008 <- filter(densityData, InclExcl == "This study")
lmExcl2008 <- lm(density ~ date, data = densityExcl2008)
```

```
summary(lmExcl2008)
```

```
##
## Call:
## lm(formula = density ~ date, data = densityExcl2008)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.28204 -0.48652  0.00572  0.54331  1.68657
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 38.3208814  7.0783934   5.414 1.95e-05 ***
## date       -0.0020633  0.0004395  -4.695 0.000111 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9091 on 22 degrees of freedom
## Multiple R-squared:  0.5005, Adjusted R-squared:  0.4778
## F-statistic: 22.04 on 1 and 22 DF,  p-value: 0.0001106
# Linear regression of density against date including 2008 estimate
densityIncl2008 <- filter(densityData, InclExcl == "This study plus [35]")
lmIncl2008 <- lm(density ~ date, data = densityIncl2008)
summary(lmIncl2008)
```

```
##
## Call:
## lm(formula = density ~ date, data = densityIncl2008)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.28021 -0.53637 -0.02703  0.59330  1.88145
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 43.4434676  5.0230233   8.649 1.10e-08 ***
## date       -0.0023798  0.0003134  -7.594 1.04e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9102 on 23 degrees of freedom
## Multiple R-squared:  0.7149, Adjusted R-squared:  0.7025
## F-statistic: 57.66 on 1 and 23 DF,  p-value: 1.037e-07
```