Computer Lab 6. Analyzing camera trap data.

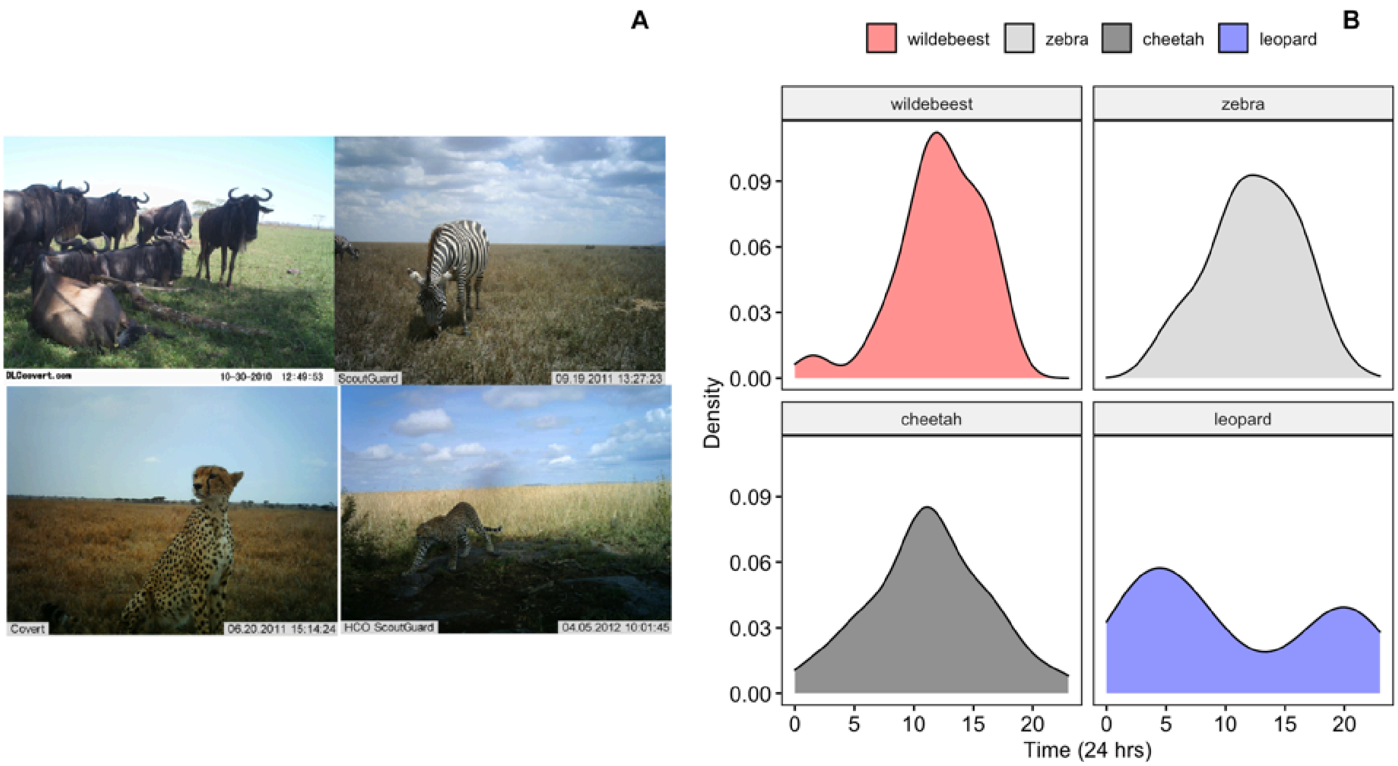


Figure 6: Images of wildebeest, zebra, cheetah and leopard from the Snapshot Serengeti image database (http://lila.science/datasets/snapshot-serengeti)

Background
In this lab we will use actual camera trap data collected in Serengeti National Park to investigate temporal niche partitioning. The camera trap data that we will use for this field lab comes from the 'Snapshot Serengeti' project (http://lila.science/datasets/snapshot-serengeti). The scientists set out out 225 cameras within a 1,125 km2 area. The cameras have been deployed continuously since 2010, and the researchers recruited citizen scientists to help with classifying images (https://www.zooniverse.org/projects/zooniverse/snapshot-serengeti).

Goals of the exercises
The main goal(s) of today's lab are to:
1) Understand the types of behavioral data that scientists can collect from camera trap photos.

2) Become familiar with one of the ways scientists can compare differences in activity patterns.
3) Think about interspecific interactions of predator-prey and potential competitors in the Serengeti.

Getting started

First we need to load the relevant packages for our data analysis. Packages contain all the functions that are needed for data analysis.

```
library(behaviouR)
library(ggpubr)
```

Part 1: Collect Serengeti camera trap data

The original dataset includes over 2.65M sequences of camera trap images (totaling 7.1M images) from ten field seasons. As you can imagine that is a lot of data! For this lab we will focus on a subset of the data collected over the course of a few seasons.

We will be taking random subsets of the camera trap photos (the current default is 5 per season which you should change for your actual study), and we use 'set.seed' to make sure that our results are reproducible.

```
set.seed(2210)
```

We can use the following code to query the database by season to see which photos are available. The available seasons are 1-4, 6-8,10,11. This function will return a table with all of the available camera trap photos for a particular season. With camera trap data often times photos will be taken in a sequence (e.g. if the animal is moving in front of the camera for a long time). The values in the table below include all photos in a sequence, but the code we use to download the photos only takes the first photo in a sequence. Therefore the sample sizes indicated in this table and the actual sample size may be different.

```
CameraTrapAnnotations(season = 1)
```

```
##
##       aardvark      aardwolf        baboon   batearedfox       buffalo
##            143            88           348           315          1455
##       bushbuck       caracal       cheetah         civet        dikdik
##             36            57           575            27           728
##          eland      elephant gazellegrants gazellethomsons       genet
##            113          1687          4967         29705            28
##        giraffe    guineafowl          hare    hartebeest  hippopotamus
##           1923          3217           327          2139           340
##    honeybadger   hyenaspotted  hyenastriped        impala        jackal
##             42          2752           112           691           304
##    koribustard       leopard    lionfemale      lionmale      mongoose
##            591            38          1519           665           290
##   monkeyvervet       ostrich     otherbird     porcupine     reedbuck
##             64           211          2322           114           946
##       reptiles    rhinoceros       rodents secretarybird        serval
##            357             6           129           198           174
##           topi       warthog     waterbuck       wildcat    wildebeest
##            428          2685            25            48           689
##          zebra       zorilla
##           5592             9
```

For this lab you are going to choose two animals from the camera trap dataset. It could be a pair of animals that are predator and prey or two potential competitors. Once you decide on the two animals you want to compare you will make some predictions about how you think they will differ in their activity patterns.

Now we will use another function to download the camera trap photos and save them locally to our computer. You can change the season by changing the values for season (remember the available seasons are 1-4, 6-8,10,11). You can change the focal animal by changing the 'AnimalID'; make sure that the spelling and case is exactly the same as in the table above. You can change the number of photos per season that you download (the default is 5). When 'create.dir' is true this will create a folder in your current working directory. For this example the folder is called 'CameraTrapPhotoszebra'. If create.dir='FALSE' all the photos will be downloaded directly to your working directory. To find the directory type 'getwd()' into your R console.

```
CombinedAnimalDF <- CameraTrapDataAccess(urlpath = "https://lilablobssc.blob.core.w
    season = list(1, 2), AnimalID = "zebra", NumPhotos = 5, create.dir = TRUE)
```

Here we isolate only the columns from the dataframe that we need.

```
CombinedAnimalDF <- CombinedAnimalDF[, c("category_id", "season", "location", "file
head(CombinedAnimalDF)
```

```
##       category_id season location                              filename
## 1975        zebra     S1      C03 CameraTrapPhotoszebra/zebra_S1_C03.JPG
## 4742        zebra     S1      C06 CameraTrapPhotoszebra/zebra_S1_C06.JPG
## 292         zebra     S1      B05 CameraTrapPhotoszebra/zebra_S1_B05.JPG
## 7513        zebra     S1      D05 CameraTrapPhotoszebra/zebra_S1_D05.JPG
## 4582        zebra     S1      C06 CameraTrapPhotoszebra/zebra_S1_C06.JPG
## 45467       zebra     S2      E02 CameraTrapPhotoszebra/zebra_S2_E02.JPG
```

The function below will allow you to enter data and look through each photo included in the 'CombinedAnimalDF' spreadsheet and enter the time that the photo was taken. You can change option='Plot' to option='Viewer' to load the photos more quickly, but you will have to expand the photo to see the whole thing. The input file should be the dataframe created using the 'CameraTrapDataAccess' function. You can break out of the function at any time by typing 'break'. It will print out which row of the dataframe you were on when you stopped the function. If you would like to resume where you left off you must change 'rowstart=1' to the row number indicated, and change 'dataframe.cont = FALSE' to 'dataframe.cont = TRUE'.

Here is the function to view photos and annotate data.

```
CombinedAnimalDF_TimeAdded <- CameraTrapDataCollection(inputfile = CombinedAnimalDF
    rowstart = 1, dataframe.cont = FALSE, option = "Viewer")
```

Now you may want to save your datasheet locally

```
write.csv(CombinedAnimalDF_TimeAdded, "CombinedAnimalDF_TimeAdded.csv", row.names =
```

Part 2: Analyze your Serengeti camera trap data

First we load your data sheet with the times added. NOTE: Make sure that your updated datasheet has the exact same name as the file indicated below.

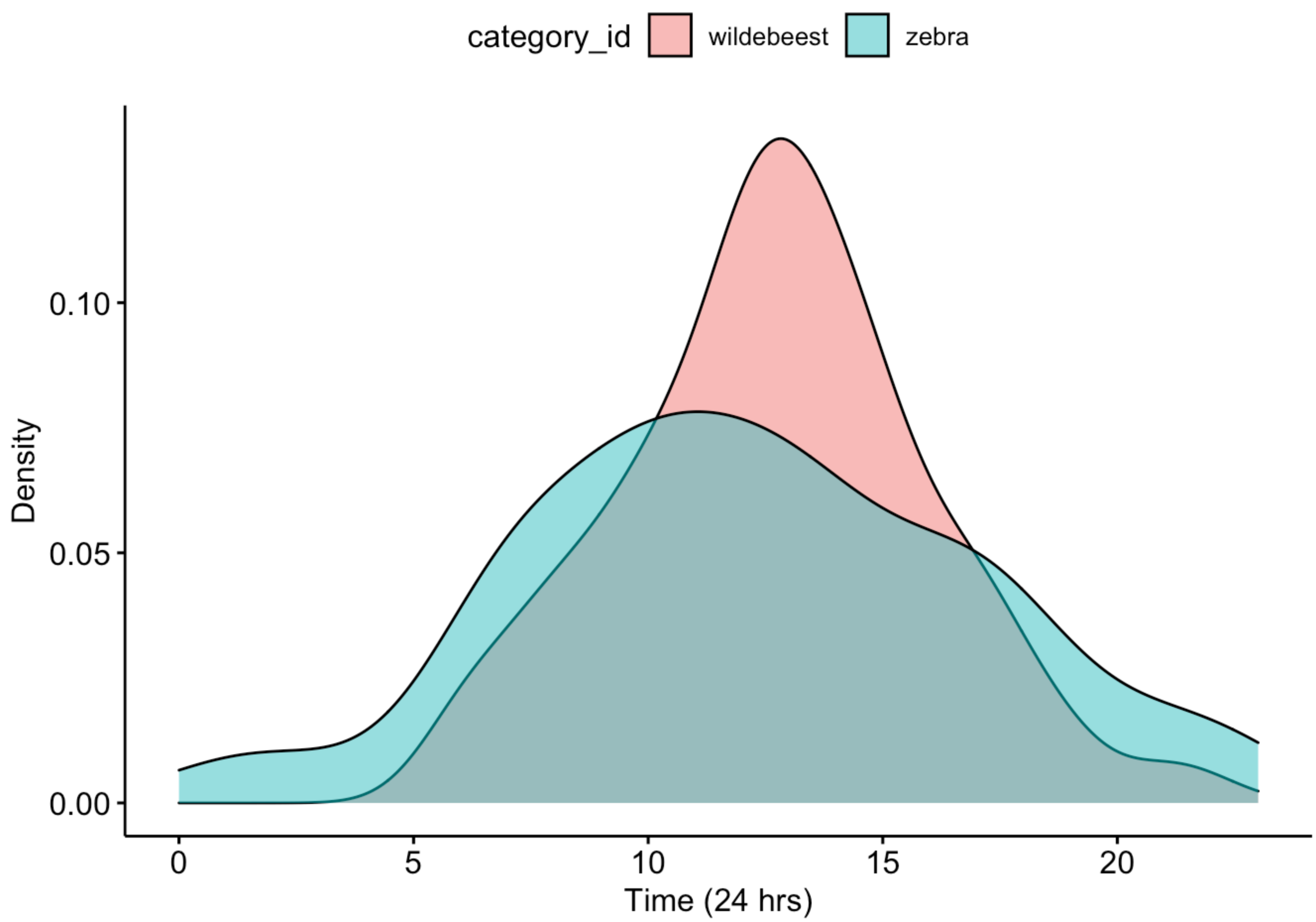
```
# You can read in your datasheet that you saved
CombinedDFTimes <- read.csv("CombinedAnimalDF_TimeAdded.csv")
```

Then we can check the structure

```
head(CombinedDFTimes)
```

Now we can make a density plot that will show the distribution of camera trap photos that were taken over 24-hours. We add the fill = 'category_id' so that we show different distributions for each animal.

```
ggpubr::ggdensity(data = CombinedDFTimes, x = "Time", fill = "category_id") + xlab(
    ylab("Density")
```



Question 1. What do you notice about the overlap of the two density curves? Does it look like there is temporal niche partitioning?

Now we can calculate an overlap coefficient which can be used to investigate potential competitive and interaction possibilities between species.The value ranges from ranges from 0 (no overlap) to 1 (complete overlap).

First we subset our data to focus on the first animal in our dataset

```
FirstAnimal <- subset(CombinedDFTimes, category_id == "zebra")
```

Then we subset our data to focus on the second animal in our dataset

```
SecondAnimal <- subset(CombinedDFTimes, category_id == "wildebeest")
```

Now we use the overlap function to calculate the overlap coefficient

```
bayestestR::overlap(FirstAnimal$Time, SecondAnimal$Time)
```

```
## # Overlap
##
## 0.81
```

Question 2. How do you interpret the overlap coefficient for your data?

Part 3: Focus on your partner’s Serengeti camera trap data

Now we will read in our partners data.
NOTE: Make sure that your updated datasheet has the exact same name as the file indicated below.

```
CombinedPartnerDFTimes <- read.csv("CombinedAnimalDF_TimeAddedPartner.csv")
```

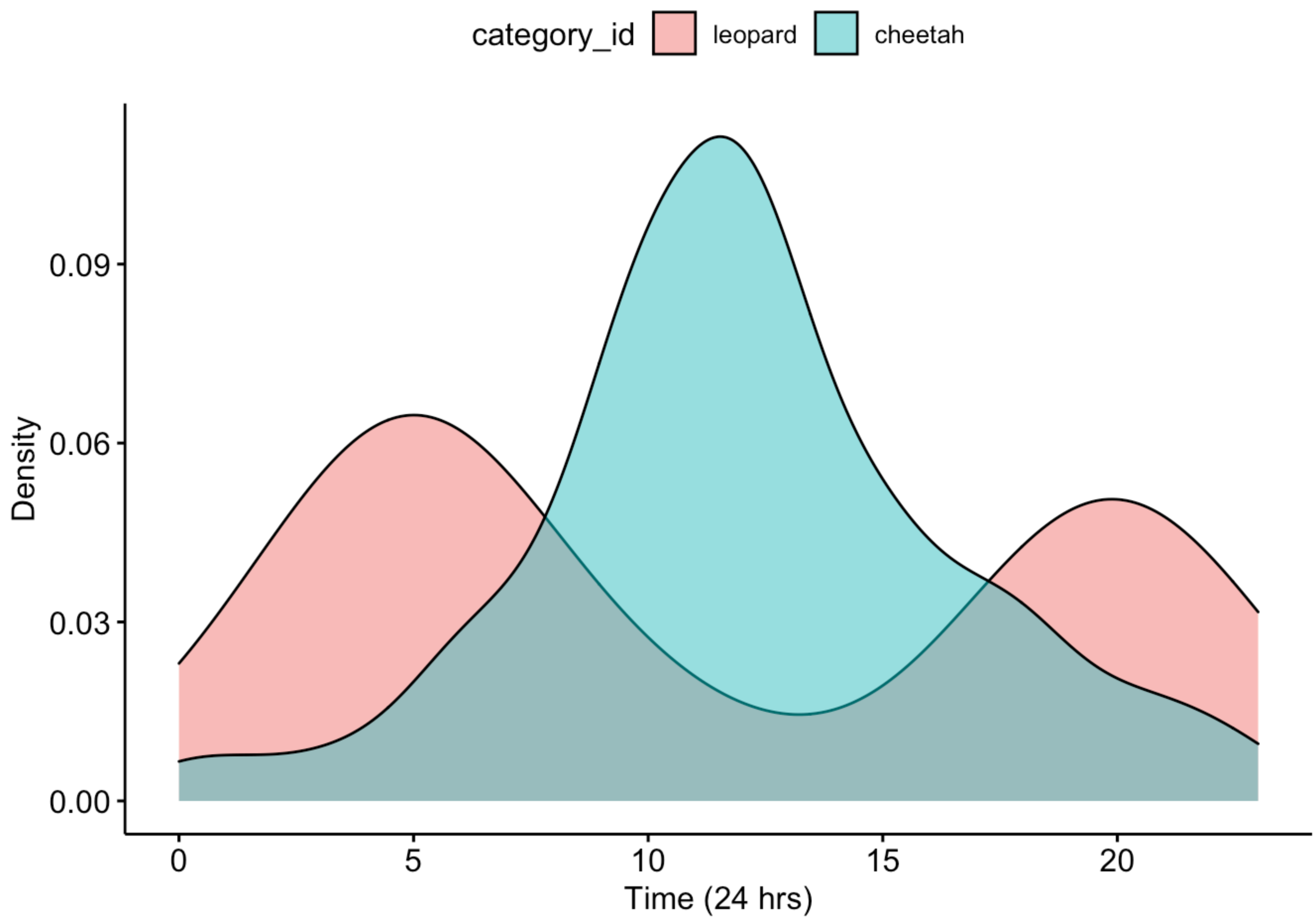
Let’s check the structure

```
head(CombinedPartnerDFTimes)
```

```
##   category_id season location                                    filename Time
## 1     leopard     S1      B06 CameraTrapPhotosleopard/leopard_S1_B06.JPG    4
## 2     leopard     S1      D06 CameraTrapPhotosleopard/leopard_S1_D06.JPG   20
## 3     leopard     S1      D06 CameraTrapPhotosleopard/leopard_S1_D06.JPG   20
## 4     leopard     S1      D06 CameraTrapPhotosleopard/leopard_S1_D06.JPG   20
## 5     leopard     S1      E06 CameraTrapPhotosleopard/leopard_S1_E06.JPG    4
## 6     leopard     S1      E06 CameraTrapPhotosleopard/leopard_S1_E06.JPG    4
```

Now we can make a density plot for our partner’s data.

```
ggpubr::ggdensity(data = CombinedPartnerDFTimes, x = "Time", fill = "category_id") +
    xlab("Time (24 hrs)") + ylab("Density")
```



Question 3. What do you notice about the overlap of the two density curves for your partner's data? Does it look like there is temporal niche partitioning?

Now we can calculate an overlap coefficient which can be used to investigate potential competitive and interaction possibilities between species.The value ranges from ranges from 0 (no overlap) to 1 (complete overlap).

First we subset our data to focus on the first animal in your partner's data set

```
FirstAnimalPartner <- subset(CombinedPartnerDFTimes, category_id == "cheetah")
```

Then we subset our data to focus on the second animal in our dataset

```
SecondAnimalPartner <- subset(CombinedPartnerDFTimes, category_id == "leopard")
```

Now we use the overlap function to calculate the overlap coefficient

```
bayestestR::overlap(FirstAnimalPartner$Time, SecondAnimalPartner$Time)
```

```
## # Overlap
##
## 0.44
```

Question 4. What is the overlap coefficient for your partner's data? How do you interpret this?

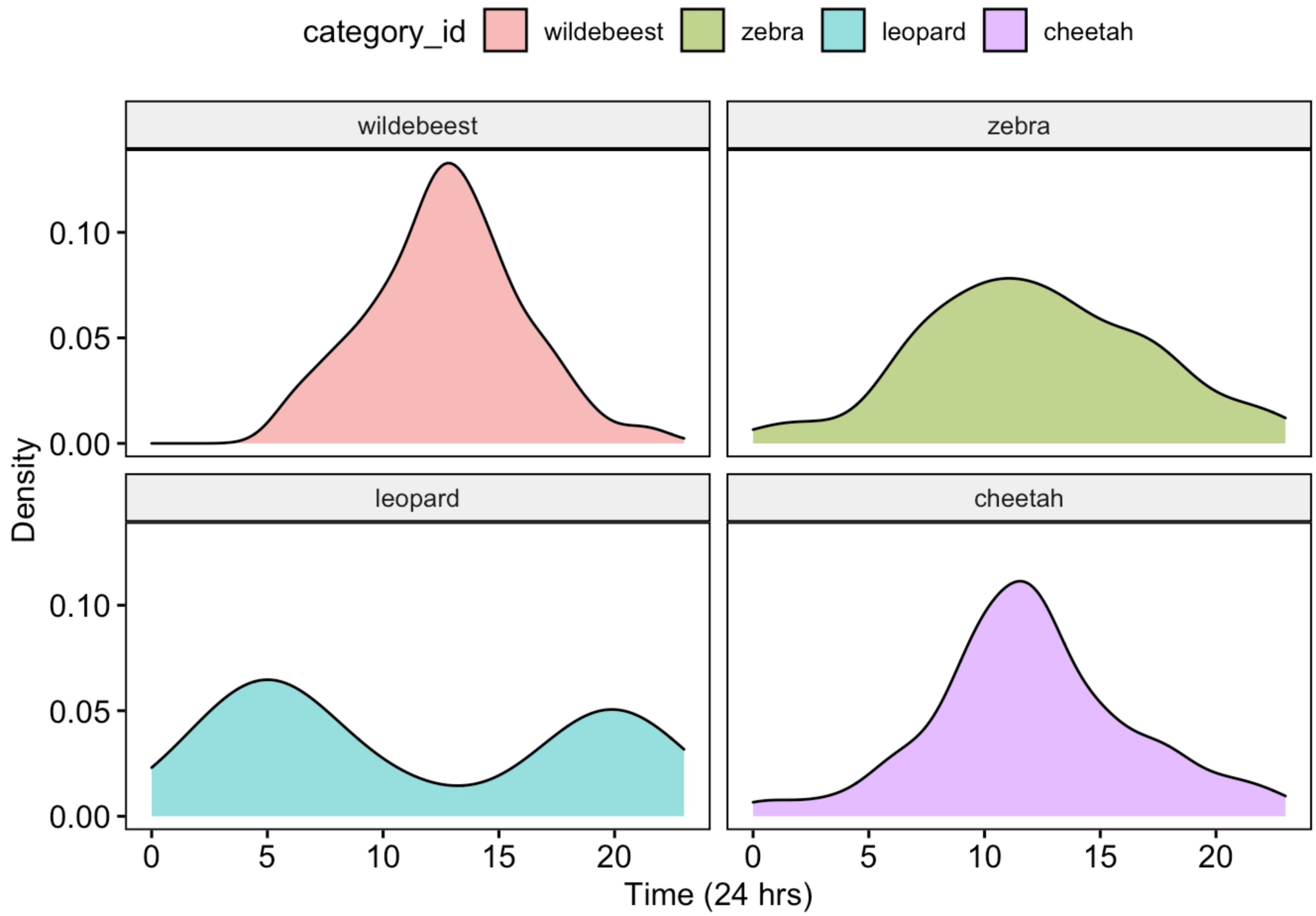
Part 4. Investigating temporal niche partitioning in four different animals

First we combine both datasets

```
AllDataCombined <- rbind.data.frame(CombinedDFTimes, CombinedPartnerDFTimes)
```

Then we plot the diel activity patterns for all four species

```
ggpubr::ggdensity(data = AllDataCombined, x = "Time", fill = "category_id", facet.by
    xlab("Time (24 hrs)") + ylab("Density")
```



Question 5. Based on the activity patterns and your understanding of the Serengeti food web how do you interpret these results? Is there evidence of temporal niche partitioning among potential competitors? What about interactions between potential predators and prey?