Female reproduction: Sexual swellings, hormones, and mating in wild baboons

A hands-on introduction to data analysis and visualization using R

**Description**

This data expedition focuses on the reproductive physiology and behavior of wild baboons. After a brief Powerpoint introduction to baboon sociality, reproduction, and mate-guarding, students will generate predictions to two hypotheses about the dataset. Students will then work through a script in R that generates several descriptive statistics and several graphs to test those predictions. Students will have to adjust parts of the script to generate the stats and graphs.

Student level and timing. This lesson is designed for undergraduate students who have little to no exposure to R or other programming software. It could be easily adjusted for students who are familiar with R or other programming software. This lesson takes about 75 minutes to complete.

Amboseli Baboon Research Project. The dataset for this expedition is a subset of the long-term database of the Amboseli Baboon Research Project, a project co-Directed by Drs. Jeanne Altmann, Susan Alberts, Beth Archie, and Jenny Tung. The Amboseli Baboons Research Project has collected demographic, behavioral, and hormonal data on a population of wild baboons for nearly 50 years in order to study questions related to animal behavior, life history, behavioral ecology, genetics, and physiology. The project’s database is managed by Jake Gordon at Duke University and Nicki Learn at Princeton University. For this data expedition, we have queried the database to replicate the dataset used in Gesquiere et al (2007).[[1]](#footnote-1)

The dataset. The unit of analysis for this dataset is a fecal estrogen sample for a cycling[[2]](#footnote-2) female. For each fecal sample (n = 896 rows), 6 variables are recorded: (1) identity of the female baboon, (2) day of her reproductive cycle, (3) fecal estrogen concentration, (4) sexual swelling size[[3]](#footnote-3), (5) whether or not the female consorted[[4]](#footnote-4) with an alpha male[[5]](#footnote-5) on that day, and (6) whether or not the female consorted with a non-alpha male on that day. This dataset includes data from 93 female baboons, with approximately 10 fecal estrogen samples per female.

**Learning objectives & their assessments**

* Increase coding skills in R
  + Adjust and run code to calculate descriptive statistics and make plots
* Increase understanding of wild animal reproduction
  + Identify associations between baboon sexual swellings, hormones, and mating behavior
* Increase science literacy skills
  + Generate predictions, think critically about data, interpret findings

**Materials**

* Powerpoint with notes to help the presenter (*Baboon reproduction data expedition\_Galezo & Levy 2020*)
* Instructions for installing RStudio and RStudio Cloud (online version) – we’ve had fewer student issues with RStudio Cloud (*Setting up RStudio Cloud*)
* R script (*RStudioCloud\_Code*)
* Dataset (*baboon\_data*)
* Worksheet (*DataExpedition\_Worksheet*)

**Class preparation**

Before class, send out instructions for installing RStudio and RStudio Cloud. We recommend using RStudio Cloud, as we experienced fewer issues with first-time users when using the online version.

**Hypotheses & predictions**

This expedition enables students to test several hypotheses related to animal signaling, sexual selection, mate choice, and mechanisms of behavior. Students will work in groups of two or three to develop predictions to hypotheses about wild female baboon reproduction. The hypotheses are:

1. Female sexual swellings are a cue of fertility that males can use to prioritize mating with fertile females
   1. Prediction 1: Peak estrogen (and ovulation) coincides with peak sexual swelling
   2. Prediction 2: Males consort with females more when females have large swellings than when they don’t have large swellings
2. High-ranking males are able to monopolize fertile females better than low-ranking males
   1. Prediction: During ovulation, high-ranking males will consort with females more than low-ranking males

**Extension**

Students who work through the script quickly should be encouraged to further explore the dataset by generating their own questions, hypotheses, and predictions and then testing them. Some possible questions include:

1. Is there between-female variation in sexual swelling sizes or estrogen levels? How might this affect male mating behavior?
2. Do some females more reliably mate with alpha males than other females? If so, what more would you want to know about those females?

**Figures**

Below are the 4 figures that students will generate to test their predictions. Figures are replications of the results of Gesquiere et al (2007). The area between the dashed and solid lines indicates when females are most likely to be ovulating.





**Reference**

Gesquiere L.R., Wango E.O., Alberts S.C., Altmann J. 2007. Mechanisms of sexual selection: sexual swellings and estrogen concentrations as fertility indicators and cues for male consort decisions in wild baboons. Hormones and Behavior 51:114-125.

1. Minor differences in the dataset used in the 2007 publication and this exercise are due to changes made over time as corrections have been made to the database. [↑](#footnote-ref-1)
2. Cycling: sexually mature but not pregnant or lactating. [↑](#footnote-ref-2)
3. Female yellow baboons exhibit exaggerated sexual swellings (an enlargement/engorgement of the genital and perineal skin) around ovulation. [↑](#footnote-ref-3)
4. The term ‘consortship’ refers to a period in which a male will mate with a female and try to exclude competing males. [↑](#footnote-ref-4)
5. Male yellow baboons have a dominance hierarchy, in which the highest-ranking male (the “alpha”) has the greatest access to females. [↑](#footnote-ref-5)