Hepatozoon infections in African squirrels: is a sex-bias present and does it matter?

Stephanie Kehler, Dr. Jane Waterman
Department of Biological Sciences, University of Manitoba - Winnipeg, Manitoba

Background

- Males and females often differ in their life history strategies and energy allocations to survival, growth, and reproduction.
- Sex-differences in energy allocation may influence parasite susceptibility, resulting in sex-biased parasitism.
- Cape ground squirrels (*Xerus inauris*) exhibit sex-biased parasitism.[1]
- Ectoparasitism is higher in male squirrels, likely because more energy is invested into testosterone production than immune function.[2]
- Female squirrels likely invest more energy into immune function than reproductive fitness.[1]
- Females also autogroom and allogroom more than males, contributing to the male-biased ectoparasitism.[1]

Autogrooming (self cleaning)

Allogrooming (cleaning others)

- These squirrels are host to an intracellular *Hepatazoon* blood parasite, transmitted by ingesting infected ticks and fleas.
- It is unknown if *Hepatozoon* infections are sex-biased or if they impact the health of infected squirrels.

Objectives

O1: Determine if *Hepatozoon* infections are sex-biased in Cape ground squirrels.

O2: Determine if *Hepatozoon* infections impact the fitness of infected squirrels.

Hypotheses and Predictions

H1: Males invest more energy into testosterone production at the expense of immune function.

P1: Male-biased *Hepatozoon* infections

P2: Infected males will have higher testosterone

H2: Grooming hypothesis – Females generally groom more than males, resulting in differences in exposure to Hepatozoons between males and females.

P3: Female-biased *Hepatozoon* infections, as females consume more infected ticks and fleas

H3: Hepatozoons affect the fitness of the squirrels

P4: Hepatozoons immunocompromise the squirrels, as they persist within their immune cells

P5: Infected squirrels will have lower survival, body condition and reproductive success

Expected Results

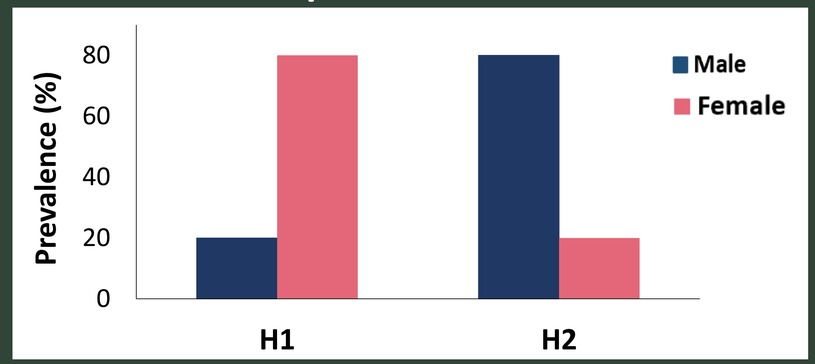


Figure 1. Expected prevalence (# of infected squirrels/total squirrels sampled in male (blue) & female (pink) squirrels for hypothesis 1 (H1) & hypothesis 2 (H2).

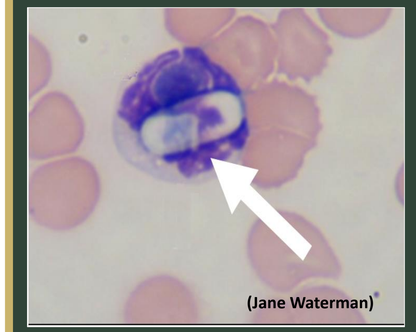
Methods

Sex-Bias Determination

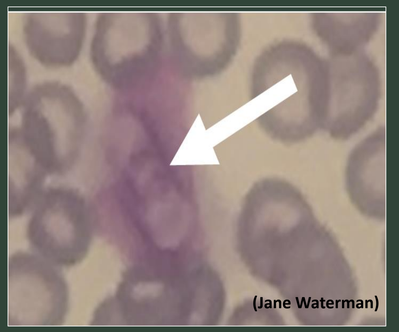
- *Hepatozoon* prevalence and % infection determined from blood smears from 2012, 2013, 2014, 2015, and 2017.
- Hormone data (2012 and 2013)

Measures of Fitness:

- Antimicrobial assays from 2013
- Regression of residuals of mass on spine length
- Neutrophil: lymphocyte ratios and hematocrit
- Survival data, site persistence, and # of offspring



Intracellular *Hepatozoon*



Extracellular *Hepatozoon*

Conclusion

- Host physiology & behavior may influence sex biases in *Hepatazoon* infections in *X. inauris*
- Understanding *Hepatozoon*-host dynamics could have implications in the veterinary industry and in conservation efforts, as Hepatozoons infect many endangered species of animals.[3]

References

[1]Hillegass, M.A., Waterman, J.M., and Roth, J.D. 2008. The influence of sex and sociality on parasite loads in an African ground squirrel. Behav. Ecol. **19**(5): 1006-1011.
[2]O'Brien, K. A., Waterman, J. M., Anderson, W. G., and Bennett, N. C. 2018. Trade-offs between immunity and testosterone in male African ground squirrels. J. Exp. Biol. **221**(16): 1-13. doi:10.1242/jeb.177683n.
[3]Pawar, R. M., Poornachandar, A., Srinivas, P., Rao, K. R., Lakshmikantan, U., and Shivaji, S. Molecular characterization of *Hepatozoon* spp. 2012. Infection in endangered Indian wild felids and canids. Vet. Parasitol. **186**(3-4): 475 - 479. doi:10.1016/j.vetpar.2011.11.036.