Factors that determine the parasitism level of the Yarrow's Spiny Lizard (*Sceloporus jarrovii*) in Arizona, USA

By: Mélanie Routh, Lucy Patterson & Gabriel Blouin-Demers
Herpetology Laboratory, Department of Biology, University of Ottawa, Canada

Résumé

L'objectif de cette étude était de tester si le niveau de parasitisme du lézard épineux de Yarrow's (*Sceloporus jarrovii*) est dicté par soit la qualité thermique ou par l'abondance des arthropodes disponible dans l'habitat. Les données ont été récoltées à l'été 2015 dans 10 sites d'échantillonnage dans les montagnes Chiricahua, Arizona. Une collection de 151 frottis sanguins, des données sur la température, l'abondance d'arthropodes et d'ectoparasites ont été récoltées. La proportion d'érythrocytes infectés par *Plasmodium sp.* a été calculée pour chaque frottis sanguin. Cette étude a trouvé que la charge d'hémoparasites augmente avec la taille du corps et diminue avec la qualité thermique de l'habitat. La charge d'ectoparasites augmente avec le nombre d'arthropodes disponible dans l'habitat et la taille du corps.

Introduction

Parasitism

- Non-mutual symbiotic relationship where an organism (parasite) feeds and reproduces at the expense of several other organisms (host).
- Malaria parasites are microorganisms from the *Plasmodium* genus that can infect the circulatory system (blood).
- Chiggers are juvenile forms of certain types of mites from the family *Trombiculidae* that feed on vertebrates.

Habitat Thermal Quality

- Deviation between the body temperature of an organism and the preferred body temperature[1].
- The effort or the energy spent by the organism to maintain a preferred temperature in its habitat.

Hypothesis

Parasitism levels are driven by (1) the thermal quality of the habitat, or (2) the arthropod (food) abundance for the host in the habitat.

Predictions

- Hypothesis 1 predicts that parasitism levels will decrease with increasing thermal quality of the habitat.
- Hypothesis 2 predicts that parasitism levels will decrease with increasing food availability.

Methods

Study sites and species

- *Sceloporus jarrovii* are relatively small, territorial lizards that live in rocky habitats.
- In summer 2015, 619 lizards (267 males and 352 females) were captured from 10 different sites in the Chiricahua Mountains, Arizona.

Field measurements

- Lizards were sexed, their snout-vent length (SVL) was measured, and the number of chiggers over their entire body was counted. Selected lizards (n = 151, 63 males and 88 females) were toe-clipped to create one blood smear per individual on a glass slide.

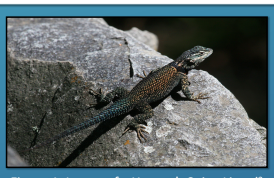

Figure 1. Image of a Yarrow's Spiny Lizard[2]

Methods

Field measurements

- We set out nine sticky traps over a 24-hour period, and counted the number of arthropods captured per trap.
- To assess the monthly thermal quality of each site, we set out one copper model containing a thermochron iButton.

Haemoparasites

- Blood smears were stained in the laboratory at the University of Ottawa using SureStain™ Wright-Giemsa stain.
- The number of red blood cells (RBC) infected by *Plasmodium sp*. for every 5,000 RBCs was counted under an optical microscope at 40x magnification.

Statistical analyses

- Thermal quality was calculated as the average difference between the environmental temperature and the preferred body temperature range of *S. jarrovii* (30.45-33.19°C[3]).
- Arthropod abundance was calculated as the monthly average number of arthropods captured.
- Two sets of statistical analyses were conducted in R using generalized linear mixed effects models. Nonsignificant variables were sequentially removed from the models until all terms left were significant.

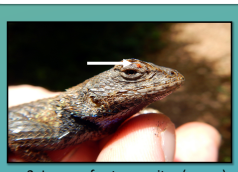

Figure 2. Image of ectoparasites (arrow) on a Eastern Fence Lizard[5]

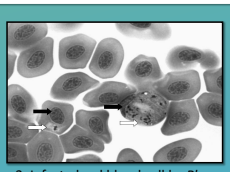

Figure 3. Infected red blood cell by *Plasmodium* sp. at 40x magnification.[6]

Results

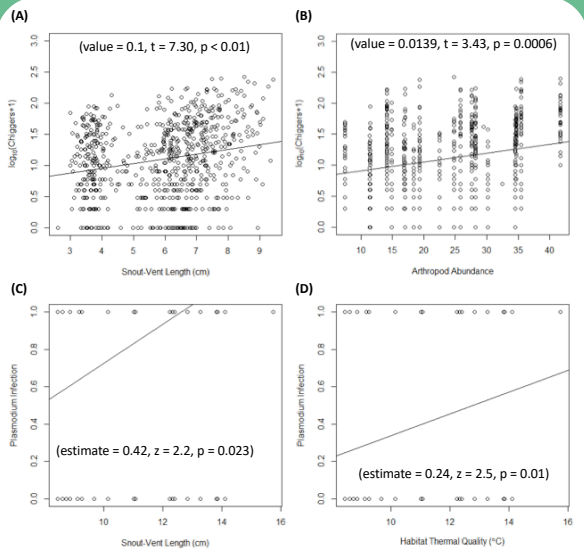

Figure 4. The relationship between $\log_{10}$-transformed chiggers and SVL (A), the relationship between $\log_{10}$-transformed chiggers and arthropod abundance (B), the relationship between Plasmodium infection and SVL (C) and the relationship between Plasmodium infection and habitat thermal quality (D).

Conclusions

- **The hypothesis on ectoparasite load was not supported.** We predicted that the ectoparasite loads would decrease with increasing food availability. This suggests that immunity is not limited by energy. According to Klukowsky (2004), lizard's chigger infections vary with the abundance of chiggers, with slope aspect and habitat moisture.
- **The hypothesis on haemoparasites was supported.** This study suggests that the infection probability of *S. jarrovii* is related to their ability to maintain their preferred body temperature.
- These results are interesting and important as it demonstrates that food availability has a different impact than what we would normally predict.
- The next steps would be to determine the factors increasing ectoparasite load with increasing food availability.

Figure 5. Map of the location of each site in the Chiricahua Moutains, Arizona.

Bibliography

[1] Hertz, P.E, Huey, R.B. and R.D. Stevenson. 1993. Evaluating temperature regulation by field-active ectotherms: The fallacy of the inappropriate question. The American Naturalist, 142: 796–818.
[2] Fray, Richard. 2015. Southeast Arizone Birding Guide, Richard Fray. <http://www.arizonabirder.com/arizona-birding-blog/page/3/>
[3] Patterson, L.D. In Prep. Food, temperature, and habitat selection in Yarrow's Spiny Lizards (*Sceloporus jarrovii*). Doctoral Thesis. University of Ottawa.
[4] Burnham, K. P. & Anderson, D. R. 2002. Model Selection and Multimodel Inference: a Practical Information-theoretic Approach. 2nd edn. New York: Springer-Verlag.
[5] Thawley, Chris. 2014. The Lizard Log: The Langkilde Lab in Action. <https://thelizardlog.wordpress.com/2014/05/29/everybody-likes-pretty-pictures/>.
[6] Bulté, G., Plummer, A.C., Thibaudeau, A. and G. Blouin-Demers. 2009. Infection of Yarrow's Spiny Lizards (*Sceloporus jarrovii*) by chiggers and malaria in the Chiricahua Montains, Arizona, The Southwestern Naturalist, 54: 204–207.

Acknowledgements

We thank Valérie Bertrand, Hannah Watkins and James Paterson for assistance in field data collection, as well as the Southwestern Research Station for logistical support.

Mélanie Routh, mrout077@uottawa.ca