Are *Callosobruchus maculatus* beetles FEELING THE HEAT? 🔥

The Effect of Temperature Change on Consumption and Emergence rates in *Callosobruchus maculatus*

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Introduction

Bean beetles, *Callosobruchus maculatus*, were used as a model system to test the hypotheses of the metabolic theory of ecology. This experiment was conducted to better understand the ideal conditions for *C. maculatus*, but also to contribute to research around the new model for metabolic rate as proposed by Arroyo et al. in 2022, in comparison to the model proposed by Gillooly et al. in 2001.

Our objective was to answer two questions:

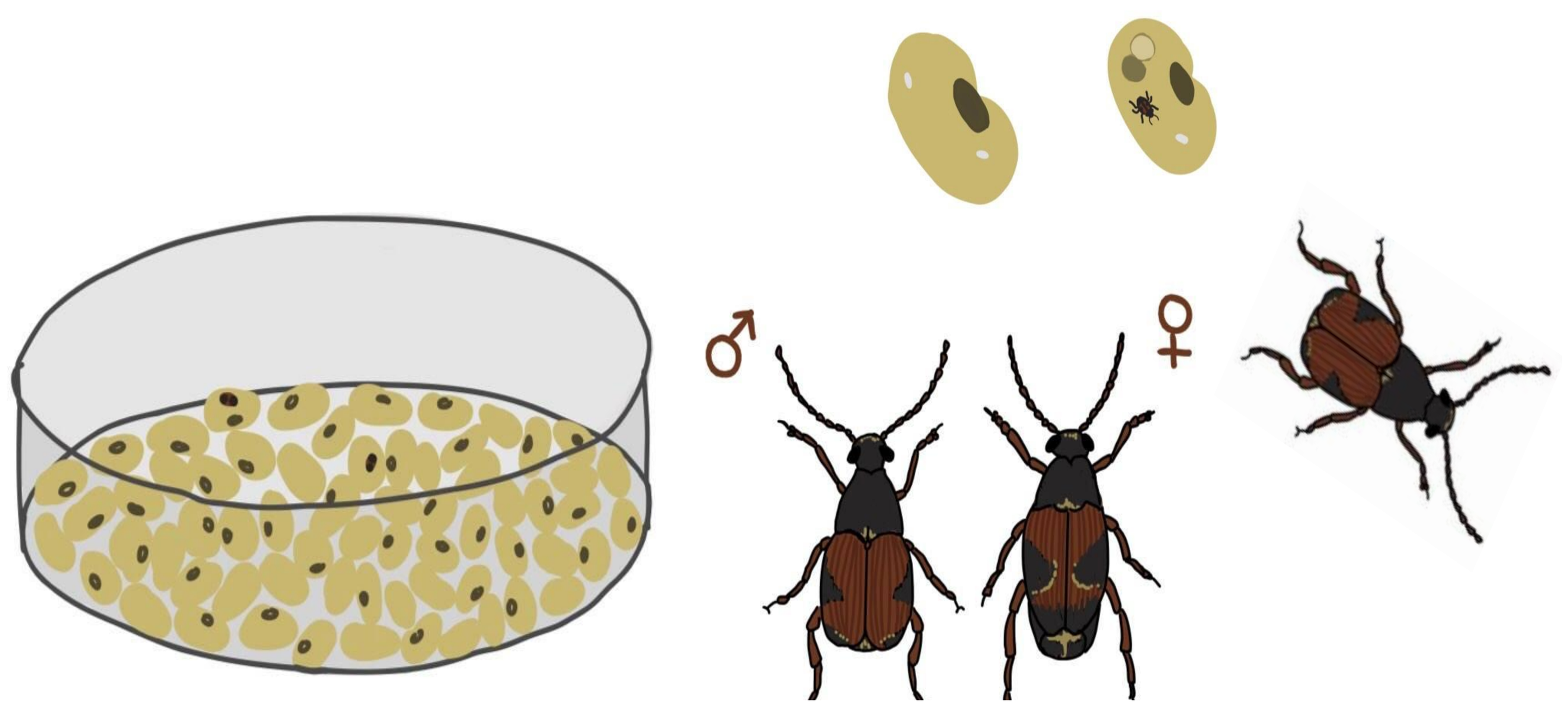
- How does temperature affect the emergence rate of *C. maculatus*?
- How does temperature affect the food consumption rate of the larvae of *C. maculatus*?

Hypothesis

An increase in temperature will result in an increase in consumption and therefore a faster emergence rate up until an optimal temperature of 30°C, after which it will be a swift decline.

Experimental Design

5 temperature sets were used, with 3 replicates and a control at each setting. The weight of beans were taken before and after emergence as a proxy for consumption, and the emergence was counted daily.



Results

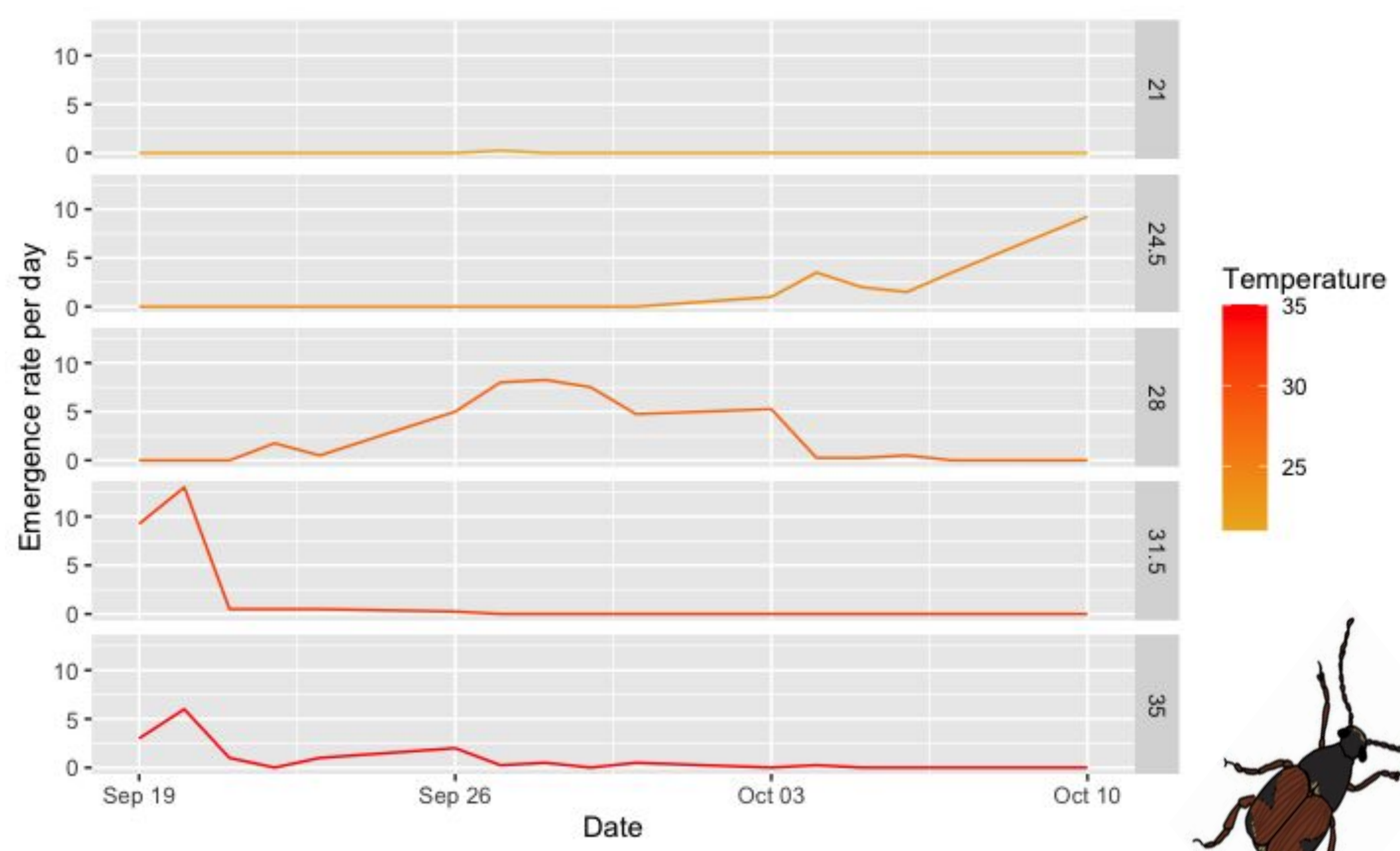


Fig. 1 The emergence rate at the different temperatures. 35° and 31.5 ° = 24 days. 28° = 27 days. 24.5° = 34 days. 21° did not emerge.

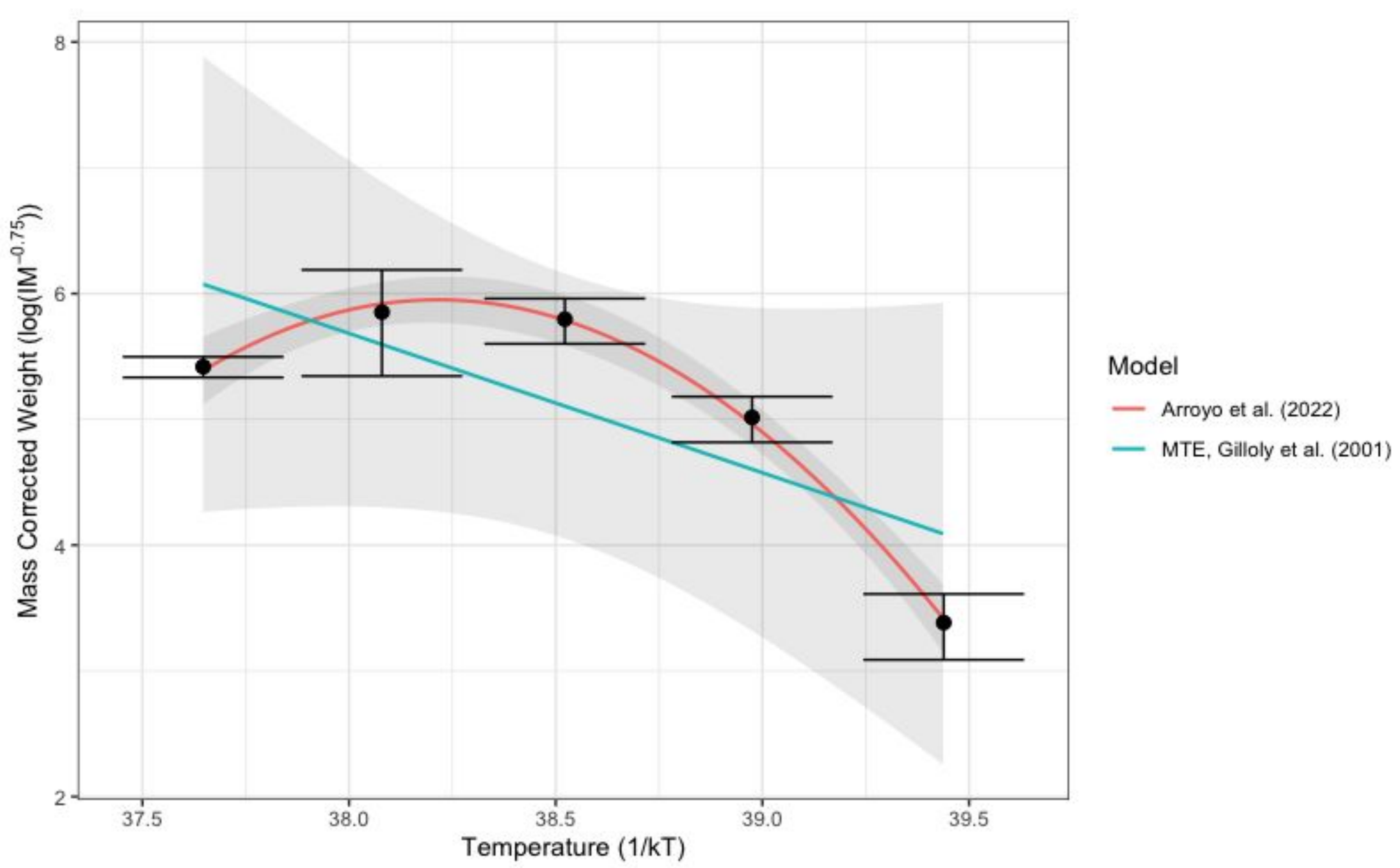


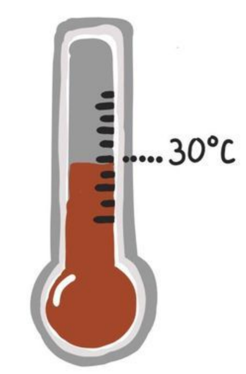
Fig. 2 The mass corrected food consumption rate fitted into the metabolic theory of ecology of respectively Arroyo et al. (2022) and MTE, Gillooly et al. (2001).

Discussion

The results found fit our initial hypothesis closely, as shown in Figures 1 and 2. Though the differences in bean weight were small, around 1%, the controls consistently averaged around 1% as well, meaning that any difference in weight could not be attributed to condensation or other external factors.

Though these results are positive, we would need to do further research, ideally with many more replicates, in order to verify the results and have a larger sample size. Further, we were unable to measure the full hatching rates of the 21.5C set due to time constraints, so we would want to repeat the experiment with more time to get a full picture of the effects of temperature change.

Our results fit the 2022 Arroyo et. al model very closely, as shown in Figure 2, and was a much better fit than the 2001 Gillooly model. This speaks to the validity of the Arroyo model and the advancements in metabolic theory.



Conclusion

To conclude, the data fit our proposed hypothesis of temperature affecting metabolic rate, and found that temperatures around 31.5C yield the best results for *C. maculatus* beetles. As well, our data closely fits the Arroyo et al. 2022 model, which supports the theory they released.

References: Arroyo, Díez, B., Kempes, C. P., West, G. B., & Marquet, P. A. (2022). A general theory for temperature dependence in biology. PNAS, 119(30), 1–e2119872119
Whitfield. (2004). Ecology's big, hot idea. PLoS Biology, 2(12), 2023–2027.

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