TEMPERATURE DEPENDENT REPRODUCTION EFFICENCY

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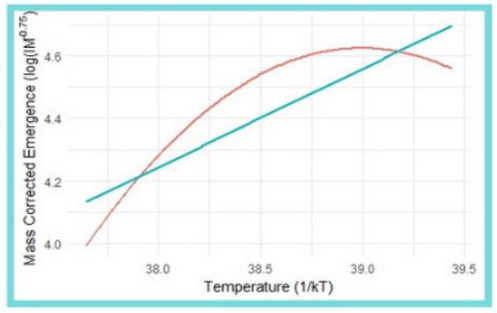
INTRODUCTION

The Metabolic Theory of Ecology presented by Brown et. al (2004) has long been regarded as the most significant equation in quantifying how metabolism affects ecological processes. 2022 was a new equation postulated by Arroyo et. al regarding the same ecological question.

To test the two equations as better fitting for this theory, we examined the reproduction efficency of bean beetles raised in different temperatures.



Graph 1:
Brown et. Al (2004) (blue)

$$\ln\left(IM^{-\frac{3}{4}}\right) = -E\left(\frac{1}{kT}\right) + \ln(i_o)$$

Arroyo et. al (2022) (red)

$$I = I_o\left(\frac{1}{T}\right)^{-\frac{\overline{\Delta C}}{R}-\alpha} e^{-\frac{\overline{\Delta H}}{RT}}$$

HYPOTHESIS

Emergance rate and development velocity of bean beatles are temperature dependent following the Arroyo et. al model (2022).

METHOD

1. **Preparation:**

• 3 petri dishes per temperature group:
21˚C, 24.5˚C, 28˚C, 31.5˚C and 35˚C.
• Add 135 black eyed beans to each petri dish
• One male and one female bean beetle (*C. maculatus*) per petri dish.

2. **Collecting data:**

• After 17 days, count all the laid eggs.
• Count the emerged adults every day for one generation (4 weeks).

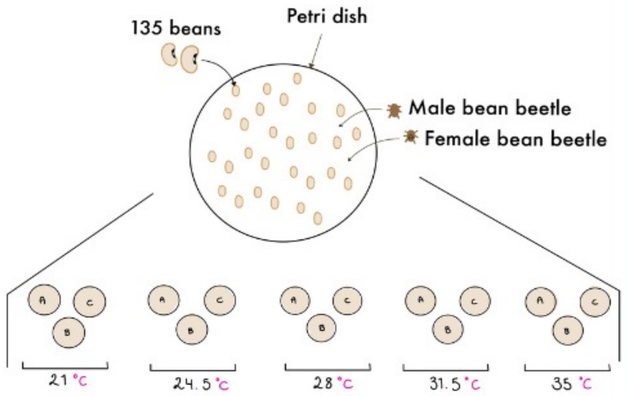
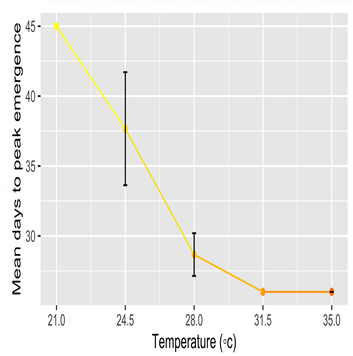


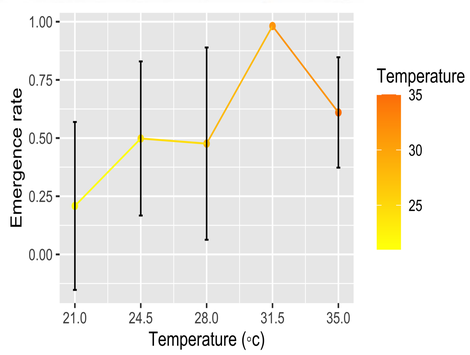
Figure 1: The preparation of each petri dish for the different temperature groups

RESULTS & DISCUSSION

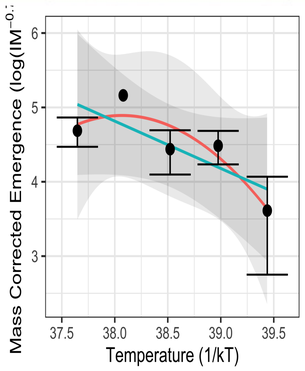
If we divide the number of emerged adults by the number of eggs laid, we get the emergence rate. Graph 2 shows this in dependence of the different temperatures. In graph 4 we took the mass corrected logarithm and fittet it to the two equations (see introduction). It is visible that the Arroyo model fits better. This is also shown by the AIC, which is lower for the Arroyo model.
We also plotted the number of days to peak emergence against the temperature (graph 3) and fittet this as the mass corrected logarithmic development to the two models (graph 5). The results were similar.



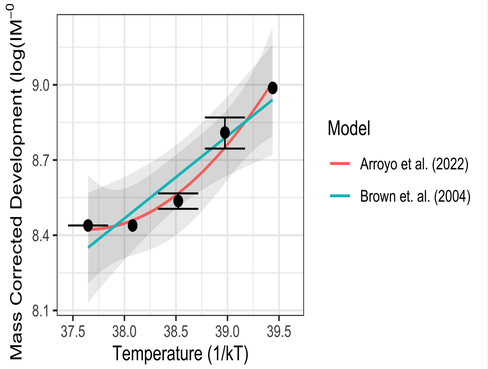
Graph 2: Emergance rate



Graph 3: Mean days to peak emergance



Graph 4: Mass corrected emergance in the different temperatures



Graph 5: Mass corrected development in the different temperatures

CONCLUSION

We can say that the reproduction efficiency, in our case examined by looking at emergence rate and development velocity, is lower in the higher and lower temperature and optimum at about 31.5°C. These results support our hypothesis.
Looking at metabolic theory on large scale, we can see this as another proof for the Arroyo model (2022).

REFERENCES

Brown paper: Brown, Gillooly, J. F., Allen, A. P., Savage, V. M., & West, G. B. (2004). TOWARD A METABOLIC THEORY OF ECOLOGY. Ecology., 85(7), 1771–1789. https://doi.org/10.1890/03-9000
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