Exploring the effects of male/female ratio and temperature on bean beetle reproduction

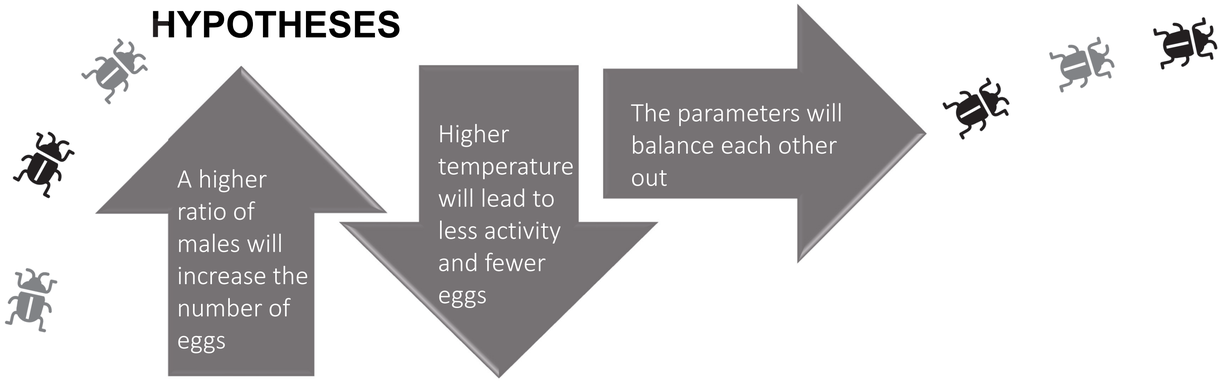
Does the ratio between males and females influence the number of eggs, and does the temperature have an impact on the number of eggs resulting from reproduction?

Torill Johansen, Marine Kleiber, Camilla Zernichow, Iben Kleppe & Frida Hinna

INTRODUCTION

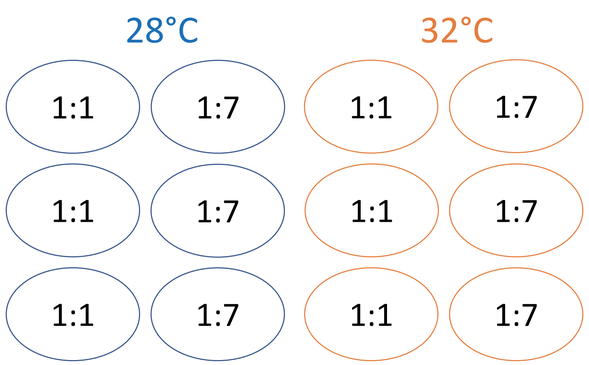
Adult bean beetles spend their short life on mating and laying their eggs on beans, where the larvae will feed and develop (Beck & Blumer, 2014). By looking at cultures at different ratios and temperatures we can see how intraspecific competition and temperature affects reproduction.

HYPOTHESES



METHOD

- Six petri dishes were kept at a temperature of 28 and 32 degrees – three at 1:1 ratio and three at 1:7 female to male ratio
- After 3 weeks the eggs were counted in each petri dish
- Data was analysed using R



DISCUSSION

As hypothesized, higher temperature leads to significantly fewer number of eggs which may be due to abiotic stress. Higher ratio of male to female do not represent a significant parameter. In fact, the 1:7 ratios tend to lead to smaller outcome of reproduction. A possible explanation may be "negative" competition between the males who focus on fighting for the female instead of reproducing. This result is also affected by one petri dish having only three eggs. This may be due to heat stress on males that causes reduced sperm production and quality (Martinossi-Allibert et al., 2017), and it is conceivable that the presence of several males caused stress to the female.

Through the experiment, our goal was to see how bean beetles behave when facing a combination of different challenges, to get an idea of their natural reproduction behaviour. In order to further understand how the ratio between males and females may influence the reproduction, we could imagine an experiment using more duplicates petri dishes, where several male : female ratios would be settled.

RESULTS

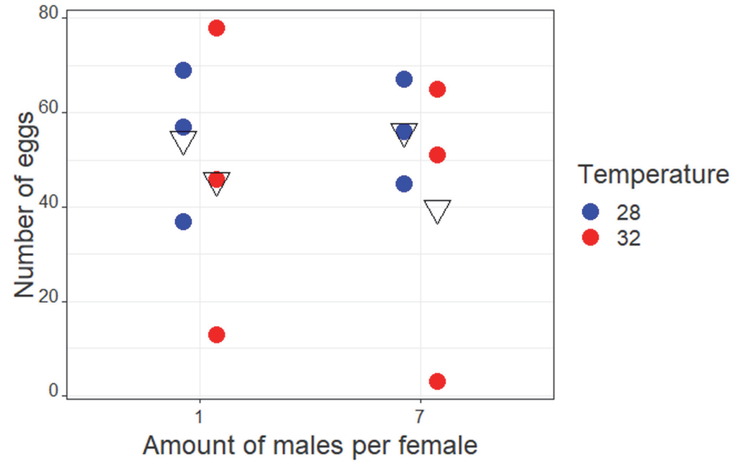


Figure1 : The exact number of eggs in each dish is represented in the figure above. One dot is representing a petri dish. The two different temperatures are given with blue dots(28°C) and red dots (32°C). The stars shows the mean of eggs for each treatment. A total of 437 eggs were laid at 28°C, 235 for the 1:1 ratio, and 202 for the 1:7 ratio. A total of 256 eggs were laid at 32°C, 137 for the 1:1 ratio, and 119 for the 1:7 ratio.

```
Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)  4.03226    0.06820  59.126  < 2e-16 ***
Temp32      -0.25694    0.08323  -3.087  0.00202 **
Ratio7      -0.04430    0.08257  -0.537  0.59160
```

Figure 2: A Generalized Linear Model (GLM) test ran on R presented different p-values, conveying different effects of temperature and ratio on the number of bean beetle eggs.
Indeed, p-value(temp) is comprised between 0.001 and 0.01 (**), the exact number being 0.00202. A p-value in this interval represents a statistically significant difference between the means of number of eggs at 28°C and 32°C. On the other hand, P-value(ratio) = 0,59160, which does not display any statistically significant difference between the means at 1:1 and 1:7 ratio.

Author contributions
MK, IK and FH made experimental design. TJ, MK, CZ, IK and FH conducted the experiment. MK and CZ analysed the data. CZ and IK created the figures. TJ visualized the poster. TJ and MK led the writing with assistance from CZ, IK and FH.

References
Beck, C. W and Blumer, L. S. (2014) *A Handbook on Bean Beetles, Callosobruchus maculatus.* National Science Foundation: *C*hristopher W. Beck & Lawrence S. Blumer.
Martinossi-Allibert, I., Arnqvist, G. and Berger, D. (2017) Sex-specific selection under environmental stress in seed beetles, *J. Evol. Biol.*, 30: 161-173. https://doi.org/10.1111/jeb.12996

UNIVERSITY OF BERGEN