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Transgenerational effects of heatwave exposure on fertility in *Drosophila melanogaster*

Biotechnology and Biological Sciences Research Council

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1. Fertility Fails Before Survival

Anthropogenically driven climate change is increasing the frequency and magnitude of heatwaves. Parratt et al. (2021) demonstrated across 43 Drosophila species that heat often sterilises individuals before it kills them. Consequently, sterility better match current species ranges and are superior predictors of population extinction and decline.

While the immediate impacts of heatwaves on fertility are well studied, the transgenerational consequences of paternal exposure and their influence on offspring resilience, remain largely unknown.

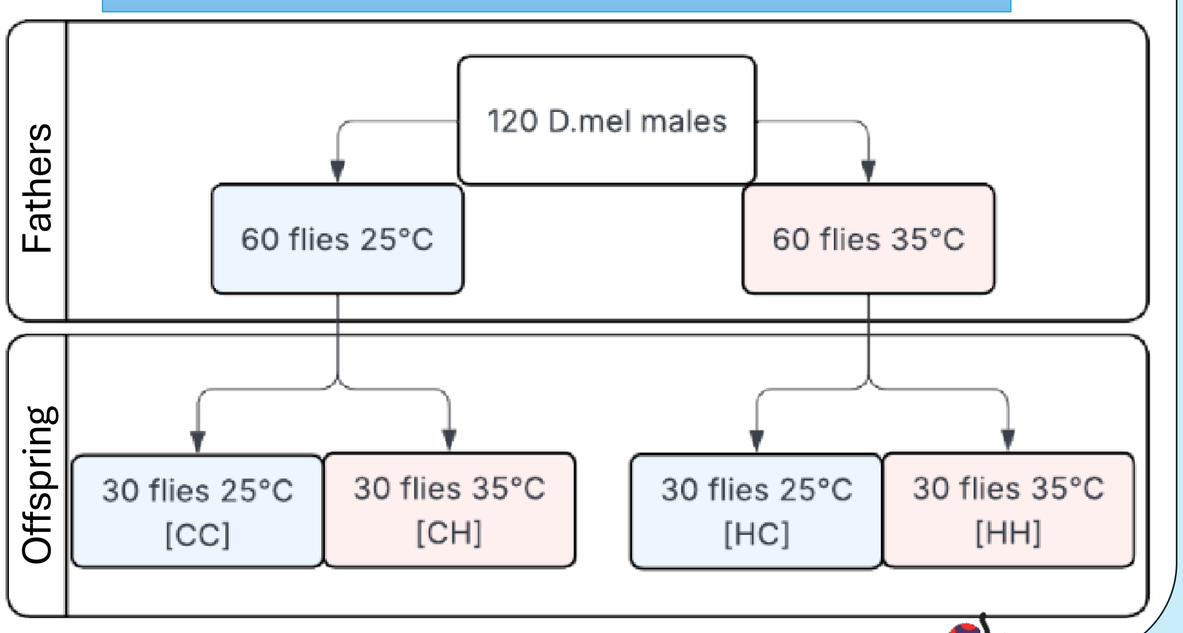
2. Research Objectives

Does sublethal heat stress induce intergenerational changes in fertility:

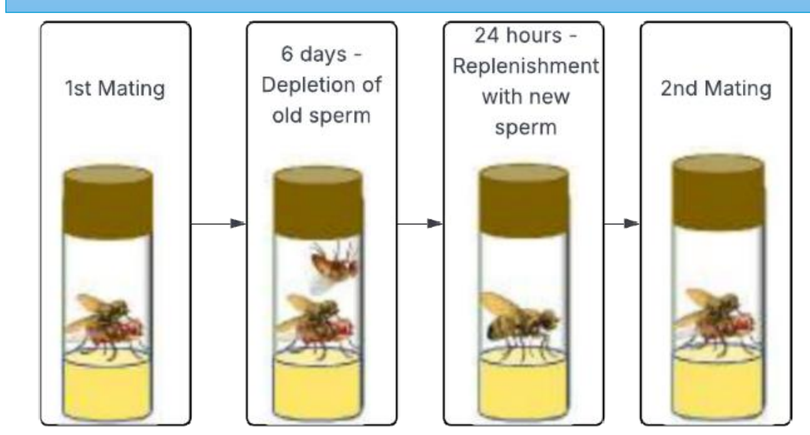
1) Assess whether offspring responses are heritable.
2) Identify whether father's heat exposure alters offspring responses.
3) Test whether effects are sex-specific.

3. Experimental Design

3a. Thermal Treatments



3b. Mating Protocol



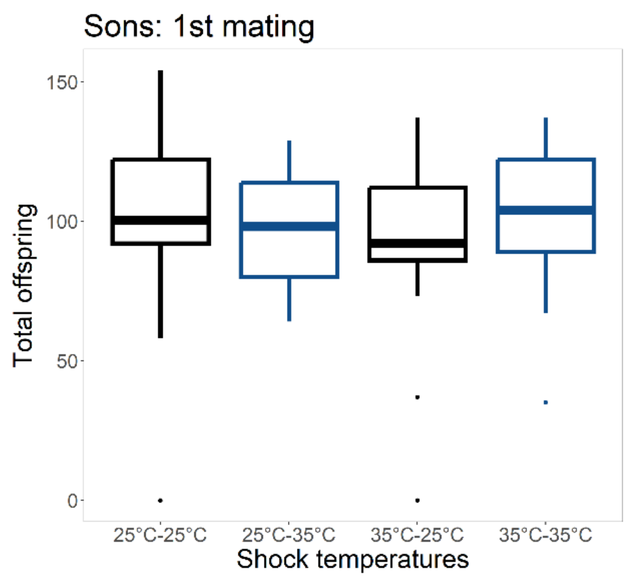
To distinguish between the effects on mature sperm directly exposed to the stress versus sperm produced post-stress, two mating opportunities were provided.

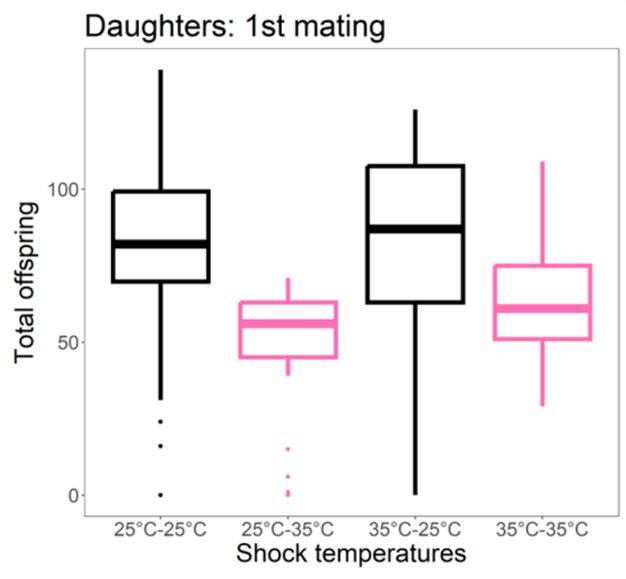
4. Key Findings

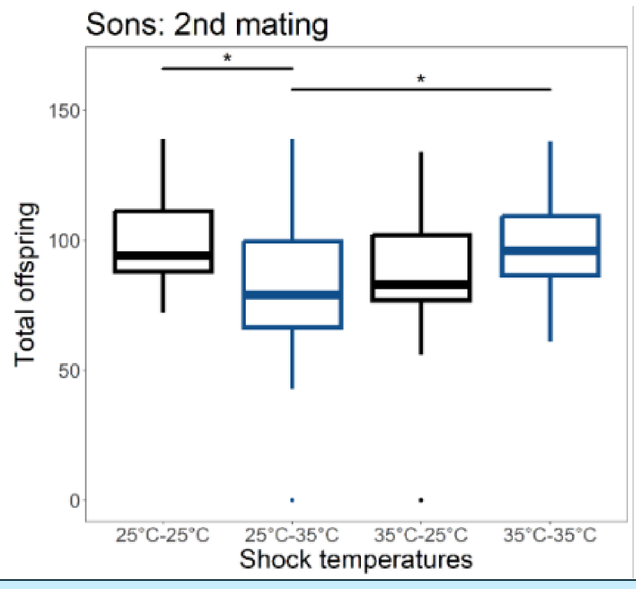
Sons: While the first mating is robust, the second mating revealed a significant interactive effect ($p = 0.00723$).

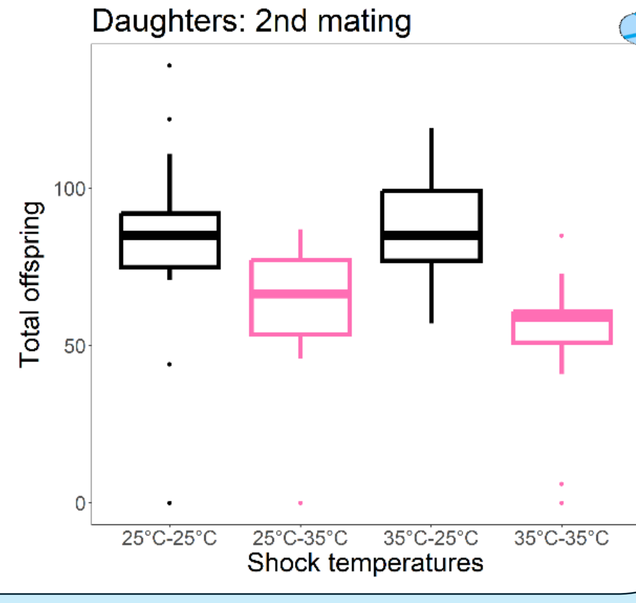
- Sons of control fathers suffered significant fertility loss when they were heat-shocked ($p = 0.0161$).
- Sons of heat shocked fathers experienced recovered fertility with significantly enhanced ($p = 0.0473$).

Daughters: Their fertility is significantly reduced by their own heat shock ($p << 0.001$) but is unaffected by their father's exposure.









5. Conclusions

Paternal priming was evidenced by the recovery of fertility sons from the second mating being more robust when fathers were heat shocked.

Daughters appear more physiologically vulnerable to direct heat stress and are not primed by their fathers.

6. Future Directions

Map gene expression changes and their roles in paternal priming by using Gal4-UAS and RNAi to target and knockout genes in specific testis cell populations.

Parratt, S.R., Walsh, B.S., Metelmann, S., White, N., Manser, A., Bretman, A.J., Hoffmann, A.A., Snook, R.R. and Price, T.A.R. 2021. Temperatures that sterilize males better match global species distributions than lethal temperatures. *Nature Climate Change*. **11**(6), pp.481–484.