Thermal Sensitivity of Male Fertility

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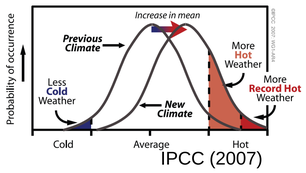
Rationale

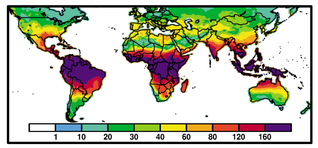
Negative effects of heat stress on **male fertility** are well established in homeotherms[1].

Very few studies have investigated heat stress effects on male fertility in **poikilotherms[2],** despite many experiencing **range shifts / extinctions** due to climate change[3].

Extreme temperature events are predicted to increase in frequency particularly at low latitudes[4,5].



IPCC (2007)



Fischer (2012)

To investigate this potentially universal constraint[2], we address three key questions:

What are the physiological mechanisms involved?

What is the impact on population viability?

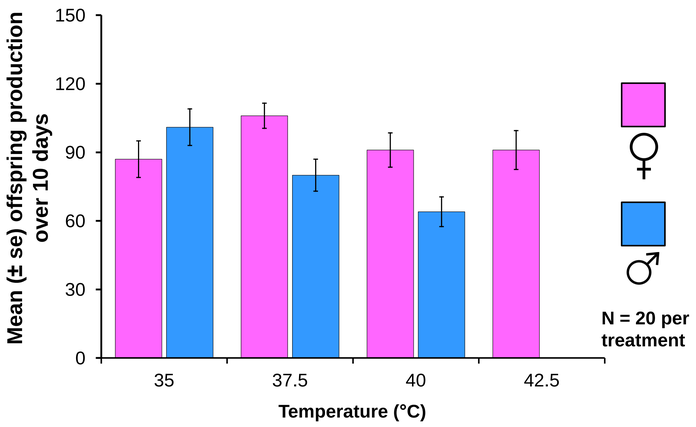
Can populations adapt?

Tribolium castaneum

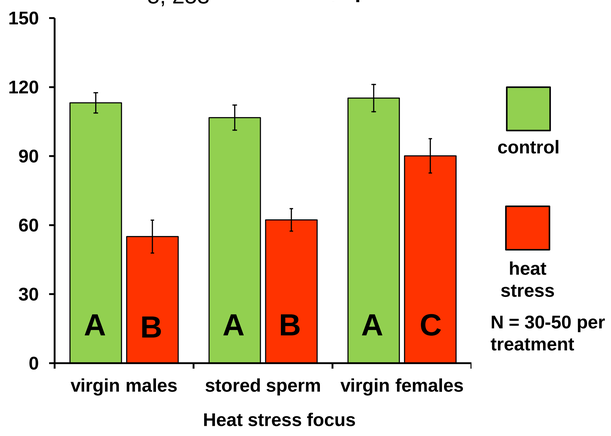
- Simple manipulation
- High experimental replication
- Representative developmental and reproductive physiology
- Known thermal niche
- Genome sequenced

What have we found?

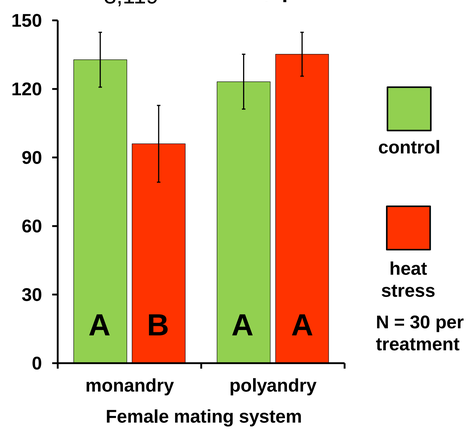
NB: Different letters identify significant differences between groups



$F_{5, 253} = 19.51,\ p < 0.001$



$F_{3,119} = 8.14,\ p < 0.001$



♂ **Male fertility decreases** with increasing heat stress.

♂ **Males are sterile** at upper limits of thermal tolerance.

♀ **Females** unaffected.

Thermal stress of mated females shows effect on **stored sperm.**

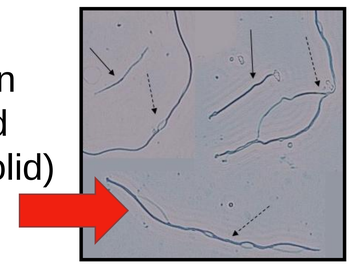
♀ Decreases in male fertility can be rescued by **female polyandry.**

Heat stress = 5 days constant exposure

What next?

Measures of **sperm form and function.**

Disintegration (dashed) and breakage (solid) of flagella.



Track **thermal adaptation** through **experimental evolution**.

Investigate **phenotypic plasticity** and **acclimation capacity.**

1) Setchell, B.P. 1998 *J Rep Fertil* **114**:179-194. **2) David, J.R.** *et al.* 2005. *J Evol Biol* **18**:838-846. **3) Thomas C.D**. *et al.* 2006 *Trends Ecol Evol* **21**:688-689. **4) IPCC 2007** *Climate change 2007: the physical science basis. Contribution of working group I to the Fourth Assessment Report of the intergovernmental panel on climate change* (eds Solomon SD, Qin M, Manning Z *et al.*) Cambridge University Press, Cambridge. **5) Fischer, E.M.** *et al.* 2012. *Geophys. Res. Lett.* **39**, L03705.