The Ecology of Sexual Conflict:
parallel evolution of male harm and female resistance in experimental populations of *Drosophila melanogaster*

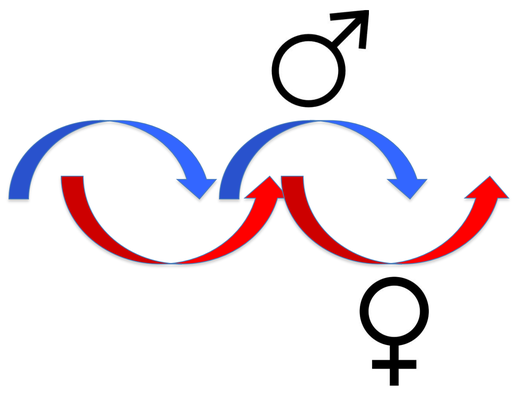
Devin Arbuthnott*, Emily Dutton, Aneil F. Agrawal, and Howard Rundle

Main Findings

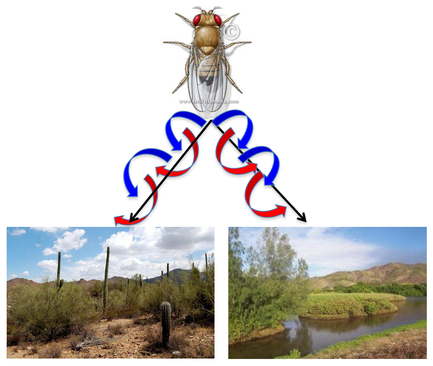
- Replicate experimental populations of fruit flies adapted to the same environment show parallel evolution of male harm and female resistance to harm.
- Ecology may play a central but undervalued role in sexual conflict and sexually antagonistic coevolution.

Background

- Sexual conflict occurs when the reproductive interests of the two sexes are not aligned. This can lead to constant antagonistic coevolution between the sexes.



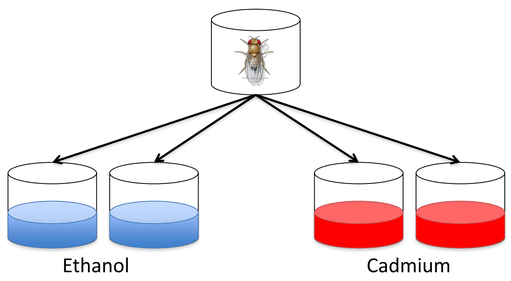
- These evolutionary arms races can promote divergence and speciation even in a constant environment, leading to sexual conflict being classified as a "non-ecological" promoter of diversification.



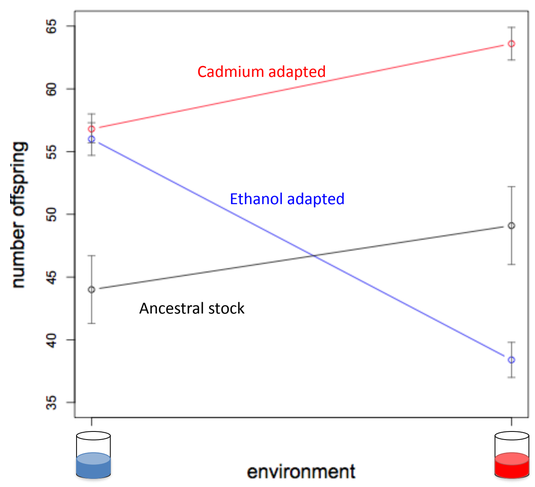
- However, ecology can have important impacts on the evolution and exaggeration of sexual traits, potentially impacting evolutionary arms races.
- We tested how adaptation to different environments affects sexual conflict.

Experimental Divergence

- We split a lab-adapted population of *Drosophila melanogaster* into 20 isolated populations exposed to one of two stressful environments: 12% ethanol or 70 mg/mL cadmium chloride.



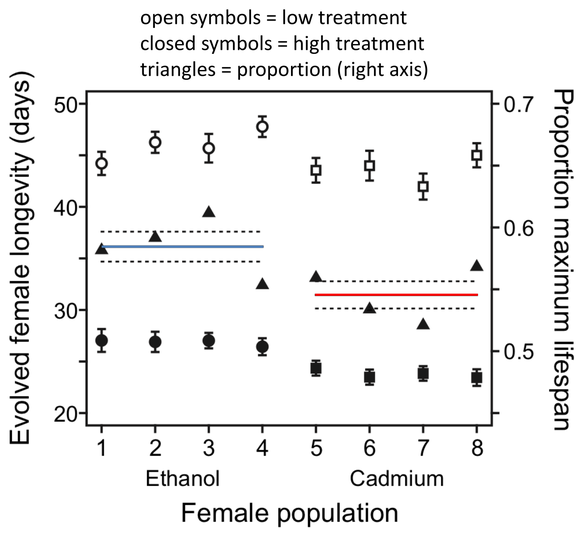
- After four years, populations show significant adaptation to their exposed environment and divergence between environments.



Female resistance

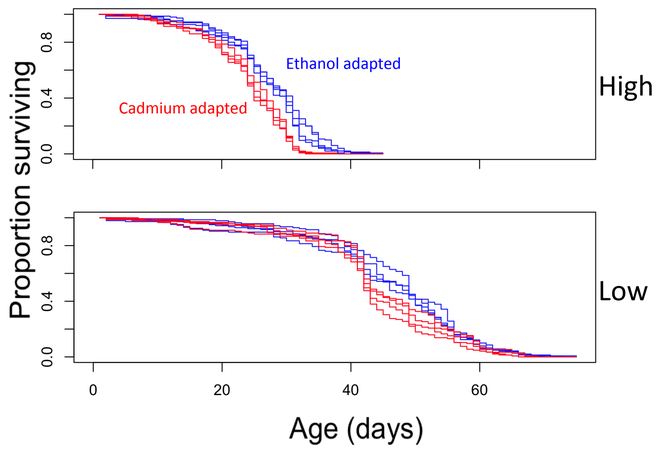
- We next tested whether divergent adaptation affected female resistance to male harm.
- Females from four ethanol and four cadmium populations were subjected to two treatments differing in exposure to stock males, high (continuous) and low (4h/week), and female longevity was measured.

- High male exposure decreased all females' longevity by almost 50% ($F_{1,11.93}$ =1519.7, $p < 0.0001$).



- Relative longevity (high ÷ low treatment longevity) approached significance ($t_{5.94}$ = 2.39, p = 0.055), where ethanol females' longevity was closer to their maximum (longevity under low male exposure).

- Ethanol female senescence increased less under the high treatment ($F_{1,10}$ = 5.47, p = 0.038), suggestive of higher female resistance to male harm.

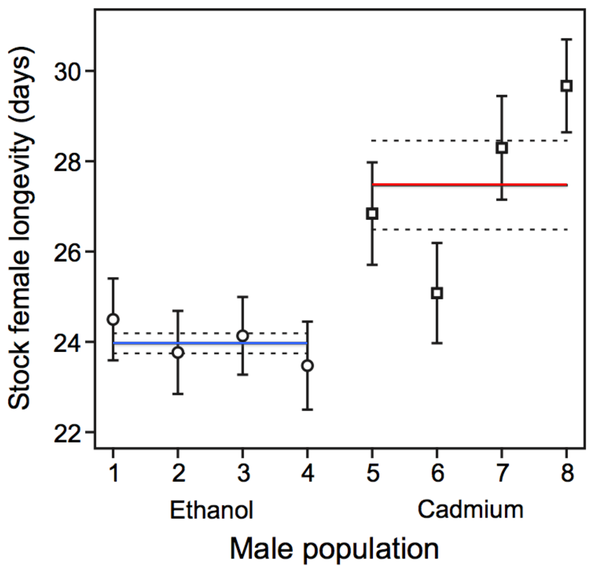


Male Harm

- We first tested whether divergent adaptation affected how harmful males are to females.
- Common stock females were continuously exposed to males from each of four ethanol and four cadmium populations. Five females were placed in a vial with five experimental males and female longevity was measured.

- Ethanol adapted males reduced female longevity more than cadmium adapted males ($F_{1,6}$ =11.96, p = 0.013).

- Environmental adaptation explained 58% of among-population variance in male harm.



Conclusions

- We observed parallel evolution of traits under sexual conflict in experimental populations of *Drosophila melanogaster*.
- Ethanol-adapted populations had more harmful males and females with greater resistance to such harm.
- Though sexual conflict is often classified as a "non-ecological" promoter of diversification, ecology and sexual conflict can interact, and ecology should be integrated into sexual conflict theory.