# Digest

# Digest: Does size matter? Condition-dependent sexual selection in Drosophila melanogaster

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Footnote: This article corresponds to De Nardo, A.N., Roy, J., Sbilordo, S.H. and Lüpold, S. (2021), Condition-dependent interaction between mating success and competitive fertilization success in Drosophila melanogaster. Evolution. https://doi.org/10.1111/evo.14228

**Abstract:** What conditions favor competitive outcomes at different stages of the reproductive process? De Nardo et al. (2021) found that in *Drosophila melanogaster*, the evolution of male secondary sexual traits was influenced by sexual selection through mating success and competitive fertilization.

## Main Text

Sexual selection alters the overall costs of reproduction in a sex-specific manner. Male competition and female mate choice have been proposed as the principal drivers of condition-dependent evolutionary change in reproductive traits of both sexes (Andersson and Iwasa, 1996). The cost of producing ejaculate may constitute an acceptable trade-off for the reproductive benefits gained from investment in secondary sexual traits. (Parker et al., 2013). While empirical studies in support of this prediction may seem inconsistent, Simmons et al. (2017) showed how overarching patterns become apparent if additional variables are included. When females mate more than once, pre- and post-mating sexual selection can produce synergistic or antagonistic interactions. Furthermore, several studies have shown how variation in condition as a result of environmental or genetic background can influence mating and fertilization success ( Liao et al., 2018, Lüpold et al., 2017, Lüpold et al., 2020).

Studying this interaction is complex, and the influence of female size on male mating and fertilization success remains a largely underexplored topic in sexual selection research. To that end, *Drosophila melanogaster,* where both sexes mate more than once, presents an ideal model system. Furthermore, females exerting mate choice before and after mating provide an excellent opportunity to explore to what extent such choice is based on variation in male and female condition, and how mating success and competitive fertilization might trade off against each other.

In this issue,  De Nardo et al. (2021) test four univariate predictions about the separate effects of sex and condition on reproductive outcomes, as well as two additional predictions about sex and condition interactions (Fig.1A). High-condition, large males were predicted to be more successful in mating and have higher paternity shares than low-condition, small males. High-condition (i.e. large) females, being better equipped to invest more time and energy in mate selection, were predicted to take longer to choose a mate and to preferentially store sperm of larger males. For interactions between sex and condition, high-condition, large females were predicted to choose larger males and demonstrate a stronger bias in fertilization success for their preferred mate. To test their hypotheses, the authors conducted experiments using the genetically modified $LH_m$ strain of *Drosophila melanogaster* expressing either red fluorescent protein (RFP) or green fluorescent protein (GFP) in their sperm heads (Manier et al., 2013). Larvae were assigned to either a high-yeast treatment or a low-yeast treatment to enhance phenotypic variation (condition/size) in adults (Fig.1B).

De Nardo and colleagues found that, as predicted, small males were less successful in mating than their larger counterparts, but overall, were more successful in post-mating sexual selection (Fig.1C). Female condition had no effect on mate preference and mating latency, and there was no interaction between male and female conditions. High-condition females did not preferentially store sperm of larger males; however, high-condition females did eject more first-male sperm when the second male was of high condition, and when the second male transferred more sperm. Male size was not found to necessarily predict sperm transfer, and female condition did not influence the preference for males in a condition-dependent manner. The authors note that these results are more telling of the experimental design than an absence of condition-dependent female mate choice.

This study by De Nardo et al. (2021) helps shine a light on the complex dynamics between pre- and post-copulatory sexual selection, secondary sexual trait evolution, and demonstrates a need to uncover additional trade-offs in between.

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