



## **Evolving Eusociality: Using *Drosophila* to understand how queen pheromone inhibits reproduction in *Apis mellifera* workers**

Author(s): Mackenzie R Lovegrove, Mackenzie R Lovegrove , Elizabeth J Duncan , Peter K Dearden

Institution(s): Biochemistry Department, University of Otago, Dunedin, New Zealand ; School of Biology, Faculty of Biological Sciences, University of Leeds, United Kingdom ; Biochemistry Department, University of Otago, Dunedin, New Zealand ; Biochemistry Department, University of Otago, Dunedin, New Zealand

The evolution of eusociality has been an enduring puzzle in biology. One key aspect of eusociality is reproductive constraint. In many eusocial hymenoptera, reproductive constraint is mediated by queen mandibular pheromone (QMP). In honeybees, evidence implies that QMP acts through the highly conserved Notch cell signalling pathway, yet how this constraint has evolved is still unknown. Interestingly, the non-eusocial, 350 million year diverged *Drosophila melanogaster* also has their reproduction impaired by exposure to honeybee QMP, similar to the repression observed in worker bees. We are exploiting this easily manipulable system to investigate potential conserved mechanisms of reproductive repression. Confirming previously published results; we show that QMP exposure causes a significant reduction in the number of mature oocytes in *Drosophila* ovaries. Extending this finding, we have demonstrated that this response is plastic and reversible by removing *Drosophila* from the QMP source and allowing ovarian development to proceed. Using RNA-seq to measure global levels of gene expression in ovaries from QMP exposed, and non-exposed *Drosophila* across various time points, including those with recovered phenotypes we have identified genes that alter their expression due to removal of QMP. That the non-social and diverged *Drosophila* responds to the eusocial honeybee QMP gives insight into potential mechanisms of QMP action. Our data implies that this response may include conserved mechanisms of responding reproductively to environmental cues. Such environmental response mechanisms may have been co-opted into reproductive constraint in eusocial species. *Drosophila* provides an excellent genetic tool to further understand both the mechanisms of QMP action, and their evolution.