The mechanistic, genetic and evolutionary basis of worker sterility in the social Hymenoptera

Author(s): Isobel Ronai, Isobel Ronai , Vanina Vergoz , Benjamin P. Oldroyd

Institution(s): School of Life and Environmental Sciences, The University of Sydney, Sydney, Australia ; School of Life and Environmental Sciences, The University of Sydney, Sydney, Australia ; School of Life and Environmental Sciences, The University of Sydney, Sydney, Australia ; School of Life and Environmental Sciences, The University of Sydney, Sydney, Australia

Extreme reproductive skew towards particular females is a defining feature of the social Hymenoptera and workers are completely sterile in at least thirteen genera. In order to understand how eusociality evolved it is essential to identify the mechanistic basis of worker sterility. We show that the developmental mechanisms that underlie worker sterility are ‘reproductive control points’ that reduce reproductive capacity in workers. We propose that environmental cues (nutritional and social) interact with particular signalling pathways in the worker and regulate worker fertility through reproductive control points both pre- and post-eclosion. We suggest that the common mechanism underlying all the reproductive control points is programmed cell death, an active process that causes the worker’s reproductive organs to degenerate. These reproductive control points are likely to have been involved in the evolution of the queen-worker dimorphism from a solitary insect. The possible order of steps is: limited resources; reproductive specialisation; and then ovary development divergence. Our mechanistic findings will also be discussed in relation to existing evolutionary theories such as the ground plan hypothesis.