

Acknowledgements

Thank you to Professor Ehab Abouheif, Claire Ramsay, the rest of the Abouheif lab. Additionally, thanks to The Office of Science Education.



How Ants Got Their Sting

Development and Evolution of Ant Eusociality



Micah Pavlidis

I am a third year Undergraduate Biology student at McGill, conducting research in the lab of Ehab Abouheif.

Email: micah.pavlidis@mail.mcgill.ca

Background

- Reproduction in ant colonies is generally performed by a small number of **Queens and Males**
- The labour of maintaining and defending the colony is performed by **reproductively constrained female workers and soldiers**
- The processes of **development** of ants within the differing **castes** reflects this **division of labour** within the colony
- The development of reproductive organs in worker ants is **constrained** to maintain social harmony¹

The Genital Disc

- An organ present in insect larvae that **develops into reproductive organs** that are associated with the ovaries or testes
- Due to importance in reproductive development, the genital disc is relevant to the evolution of the **reproductive division of labour**
- Workers of the species *Pheidole dentata* are completely non-reproductive – if the only role of the genital disc is reproductive development, we would expect it to be absent in the larvae of workers

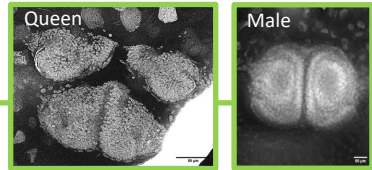


Figure 1: In *Pheidole dentata*, the differences larval genital discs in males and Queens reflects their diverging developmental pathways into male or female reproductive structures.

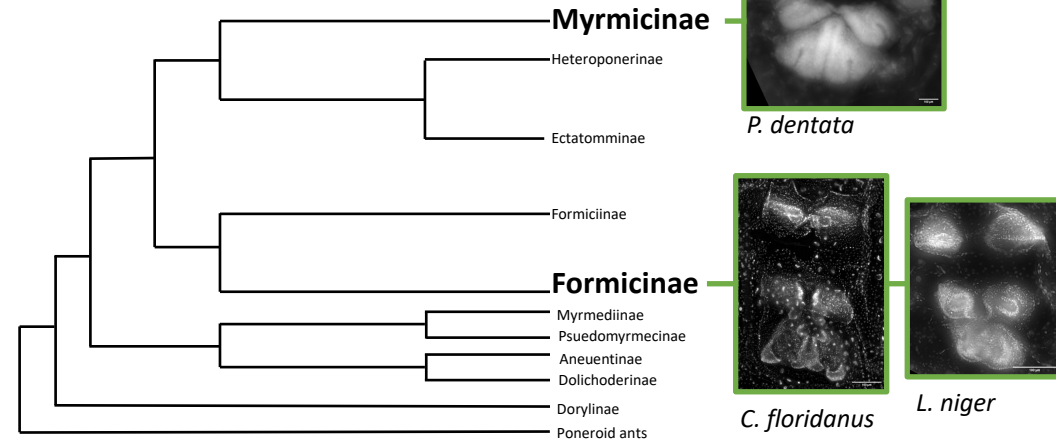


Figure 3: The genital disc is present in the larvae of workers of multiple genera within the Formicoid clade on the phylogenetic tree of ants. Images represent examples of the genital disc in late larval workers within Myrmecinae and Formicinae. Worker fecundity varies between the three species shown, despite the conserved presence of the genital disc.



A colony of Myrmecine ants of the species *Pheidole pallidula*.

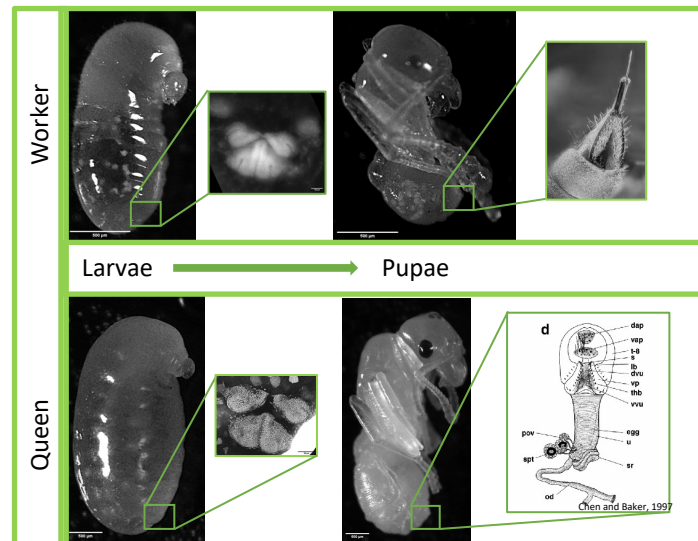


Figure 2: The genital discs of Queens and workers show no differences at the end of larval development. Despite the apparent similarity, Queens develop a suite of internal and external reproductive organs (here represented by the genital disc products of *Drosophila*), whereas workers develop a sting.

Why Is the Genital Disc Present in the Larvae of *P. dentata* Workers?

- 1) A literature search confirmed that the **ovipositor** – an egg laying organ – is a developmental product of the genital disc in many insects
 - But the reproductive role of the ovipositor is largely **redundant** in worker ants
 - The ovipositor has evolved a new function as a sting used for colony defense

The genital disc is the focal point for the developmental basis of the evolution of the sting in ants

- 2) Allometry – body scaling
 - **wing discs** have been shown to be implicated in head to body size ratios within the genus *Pheidole*³
 - Physically eliminating the genital disc during larval development is the a way to test this hypothesis

References

1. Khila, A., & Abouheif, E. (2008). Reproductive constraint is a developmental mechanism that maintains social harmony in advanced ant societies. *Proceedings of the National Academy of Sciences*, 105(46), 17884-17889. <https://doi.org/10.1073/pnas.0807351105>
2. Chen, E. H., & Baker, B. S. (1997). Compartmental organization of the *Drosophila* genital imaginal discs. *Development*, 124(1), 205-218. <https://doi.org/10.1242/dev.124.1.205>
3. Rajakumar, R., Koch, S., Couture, M., Favé, M.-J., Lillo-Ouachour, A., Chen, T., De Blasis, G., Rajakumar, A., Ouellette, D., & Abouheif, E. (2018). Social regulation of a rudimentary organ generates complex worker-caste systems in ants. *Nature*, 562(7728), 574-577. <https://doi.org/10.1038/s41586-018-0613-1>