Worker ants of the world, unite! You have nothing to lose but your fertility

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(PhysOrg.com) -- The highly specialized worker castes in ants represent the pinnacle of social organization in the insect world. As in any society, however, ant colonies are filled with internal strife and conflict. So what binds them together? More than 150 years ago, Charles Darwin had an idea and now he's been proven right.

Evolutionary biologists at McGill University have discovered molecular signals that can maintain social harmony in ants by putting constraints on their fertility. Dr. Ehab Abouheif, of McGill's Department of Biology, and post-doctoral researcher, Dr. Abderrahman Khila, have discovered how evolution has tinkered with the genes of colonizing insects like ants to keep them from fighting amongst themselves over who gets to

reproduce.

"We've discovered a really elegant developmental mechanism, which we call 'reproductive constraint,' that challenges the classic paradigm that behaviour, such as policing, is the only way to enforce harmony and squash selfish behaviour in ant societies," said Abouheif, McGill's Canada Research Chair in Evolutionary Developmental Biology.

Reproductive constraint comes into play in these ant societies when evolutionary forces begin to work in a group context rather than on individuals, the researchers said. The process can be seen in the differences between advanced ant species and their more primitive cousins. The study was published in the Nov. 18 edition of the *Proceedings of the National Academy of Sciences*.

Ants – organized in colonies around one or many queens surrounded by their specialized female workers – are classic examples of what are called eusocial organisms.

"More primitive, or ancestral, ants tend to have smaller colony sizes and have much higher levels of conflict over reproduction than the more advanced species," Abouheif explained. "That's because the workers have a much higher reproductive capacity and there is conflict with the queen to produce offspring."

To their surprise, Khila and Abouheif discovered that "evolution has tinkered with the molecular signals that are used by the egg to determine what's going to be the head and what's going to be the tail, to stop the worker ants from producing viable offspring," Abouheif explained. "Different species of ants have different levels of this "reproductive constraint," and we believe those levels provide a measure of how eusocial the colony is. The less the workers reproduce, the more coherent the group becomes."

The existence of sterile castes of ants tormented Charles Darwin as he was formulating his Theory of Natural Selection, and he described them as the "one special difficulty, which at first appeared to me insuperable, and actually fatal to my theory." If adaptive evolution unfolds by differential survival of individuals, how can individuals incapable of passing on their genes possibly evolve and persist?

Darwin proposed that in the case of ant societies natural selection applies not only to the individual, because the individual would never benefit by cutting its own reproduction, but also to the family or group. This study supports Darwin's prescient ideas, and provides a molecular measure of how an entire colony can be viewed as a single or "superorganism."

Source: McGill University