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Wingless workers are the innovation underlying the evolutionary success of ants

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Ant colonies are organized similarly to those of wasps and bees: reproductive altruism, age polyethism, complex communication and perennial nests. Yet ants have achieved much greater ecological dominance, and their lifestyles and diets are more diverse. Thus factors other than sociality must be involved, and I argue that the basic design of ant workers was decisive. An ancestral commitment to ground-living is reflected by both a shift to prognathy and the evolution of wingless helpers. First, forward-pointing mandibles allow for effective manipulation of objects or prey. Mandibles thus become multi-purpose tools that are assisted by specialized musculature in the head and prothorax (Keller et al. 2014). Second, winglessness permitted a complete dissociation between reproductives and helpers, hence phenotypes well-suited for novel foraging behaviours and ecological niches. The design of ant workers also allowed lowering per capita costs: loss of wing muscles, smaller size, thinner cuticle, elimination of superfluous organs, and age-related reduction of metabolic costs (e.g. brain, muscles, poison gland) in the context of polyethism. Cheaper workers removed limitations on increased colony size unseen in wasps and bees, leading to new strategies of resource utilization. Conversely, ant queens became more expensive because of the acquisition of substantial metabolic reserves prior to dispersal, further increasing caste dimorphism. This means that queens of most formicoid species do not need to forage while they found alone - an adaptation unknown in social wasps and bees. I compare poneroid and formicoid species to highlight some of the modifications in morphology from aculeate wasps. The evolution of cheaper wingless workers and costly queens is unique to the ants. Flying constraints in wasp and bee workers - infertile just as in ants - make such divergence impossible. Keller R.A., C. Peeters & P. Beldade (2014) eLife 3:e01539