Convergent evolution of a stronger but leaner flightless thorax in workers across ant subfamilies

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Freed from flight constraints, the thorax of ant workers evolved musculoskeletal modifications for the crucial function of transmitting force between the head, abdomen and supporting legs. An enlarged first segment (prothorax) houses the neck muscles that control head movement and allow mandibles to manipulate and lift objects. In the last segment (propodeum), space freed by the lack of wing muscles is filled by sizeable petiole muscles that determine effectiveness of the sting. Moreover, larger leg muscles extend more dorsally relative to queens. Fused dorsal plates and reduced sclerites in the worker thorax are routinely treated as taxonomic characters, with scant discussion of their functional significance. We compared thorax exoskeleton across ant subfamilies (SEM) and used micro-CT to study the musculature of *Euponera, Cataglyphis* and *Messor*. Workers in most Ponerinae and Amblyoponinae retain a bulky midthorax similar to that of queens, even though the large dorsal plate is vestigial given it no longer supports wings or wing muscles. In contrast, the midthorax is dramatically reduced in Dolichoderinae, Formicinae and Myrmicinae (plus scattered genera in other subfamilies), resulting in the hourglass-shape typical of ants. Moreover, complete fusion of the pronotum and mesonotum (first and second dorsal plates) evolved at least five times independently (including all Myrmicinae and most Dorylinae), allowing neck muscles to enlarge and extend posteriorly. We suggest that convergent streamlining of the thorax indicates additional adaptations for ground labor, relative to subfamilies whose workers retain an ancestral bulky thorax. A stronger but leaner thorax benefits colonial economy, together with thinner cuticle (Peeters et al. 2017) and increased queen-worker divergence in body sizes. Thoracic optimization may underlie the disproportionately high species numbers in subfamilies Formicinae and Myrmicinae.