Ants shape their thoraces to match the tasks they perform

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An ambitious ant carries a large piece of cut grass back to the nest. Worker ants grow specialized hypertrophied neck-muscles during development that allow them to lift and carry objects many times their own weight. Queens, which are otherwise genetically similar, do not have this adaptation Credit: Alex Wild, alexanderwild.com

It was now discovered that the specialization of queen and worker ants

goes beyond the presence or absence of wings. In a study published in the open access scientific journal *eLife*, Roberto A. Keller and Patrícia Beldade from the Instituto Gulbenkian de Ciência (IGC, Portugal), in collaboration with Christian Peeters from Université Pierre et Marie Curie (France), showed that ants grow the size of their thoracic segments differently according to the specialized tasks they will perform as adults. In particular, the researchers discovered that worker ants have a unique thoracic architecture that explains how they are able to hunt and carry preys many times their own weight.

Insects that live in society are intriguing creatures, showing an interesting interplay between their morphology (size and shape) and their behavior. Though sharing a similar set of genes, individuals within a colony play different roles and often vary in size and shape. True for social bees and wasps, ants take this to an extreme: large winged queens ensure colony reproduction whereas smaller wingless workers guarantee colony maintenance. Roberto A. Keller, researcher at Beldade's laboratory and first author of this article, has now examined in detail the thorax of most living and extinct ant subfamilies. The thorax is a part of the insect body that contains the segments bearing the wings and legs. Keller observed that in workers the thoracic segment closer to the head is greatly enlarged and filled by strong neck muscles. These muscles power the movements of the head, which in turn contains the jaws that ants use to grab and manipulate objects. A strong yet flexible neck gives worker ants the ability to use their heads to lift objects many times their own weight. Queens, on the other hand, do not have such powerful neck muscles and correspondingly have a reduced segment.

Still, the researchers observed two distinct types of queen thorax that were associated with the strategies used by queen ants to found new colonies (this is done, for the most part, without the help of workers). In some species, after dispersal by flight, the queen will lay eggs and take care of them without going out to look for food. In order to have enough

energy to feed the first generation of workers of the new colony, the queen 'dissolves' her wing muscles and reabsorbs them. In this case, queens have an enlarged wing segment and an extremely reduced neck segment. In other species, queens go through a worker-like phase and hunt to feed the new colony before there are enough new workers to take up that role. These queens have both an intermediate wing segment and an intermediate neck segment, more similar to the one observed in the workers.

"Our analysis of morphology shows that worker ants are much more than just smaller and wingless versions of queens, and have a body plan that provides great strength and maneuverability to their heads. It also shows that queens that start new colonies without the help of workers can have two types of body plans associated to whether they go through a worker-like hunting phase or not", says Patrícia Beldade.

Roberto Keller adds: "Our new findings might help explain the ants' extraordinary ecological success and evolutionary diversifications in comparison to other social insects."

The environment has been shown to play a role in the development of different individuals from the same species. In this case, queen and worker ants typically develop to be quite distinct adults based on how much food they get as larvae. Larvae that get less food develop to be workers. Yet, the molecular mechanisms that result in the differentiation of adults are still unknown.

More information: Keller, RA, Peeters, C, and Beldade, P. Evolution of thorax architecture in ant castes highlights trade-off between flight and ground behaviors. *eLife* 3: e01539. elife.elifesciences.org/lookup … /10.7554/elife.01539

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