Fighting fit cockroaches have 'hidden strength'

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Photograph of a male wide-horned hissing cockroach (Gromphadorhina oblongonota) Credit: Dr Ian Skicko

A new study has discovered that not all cockroaches are equal and "super athletes", with larger respiratory systems, are more likely to win physical

mating battles.

The research, published in the journal *Animal Behavior* and led by Dr. Sophie Mowles of Anglia Ruskin University (ARU), studied aggressive interactions between male wide-horned hissing cockroaches (Gromphadorhina oblongonota).

Animal contests are usually won by the larger opponent and physical fighting is often avoided if clear differences exist between competitors. However, during a series of laboratory contests, the researchers closely matched the cockroaches for size so there were no visible differences in their fighting capabilities, known as their resource holding potential.

Heavily weaponised male wide-horned hissing cockroaches use their pronotal horns as they compete for females through vigorous contests, often butting and flipping their male opponents onto their backs.

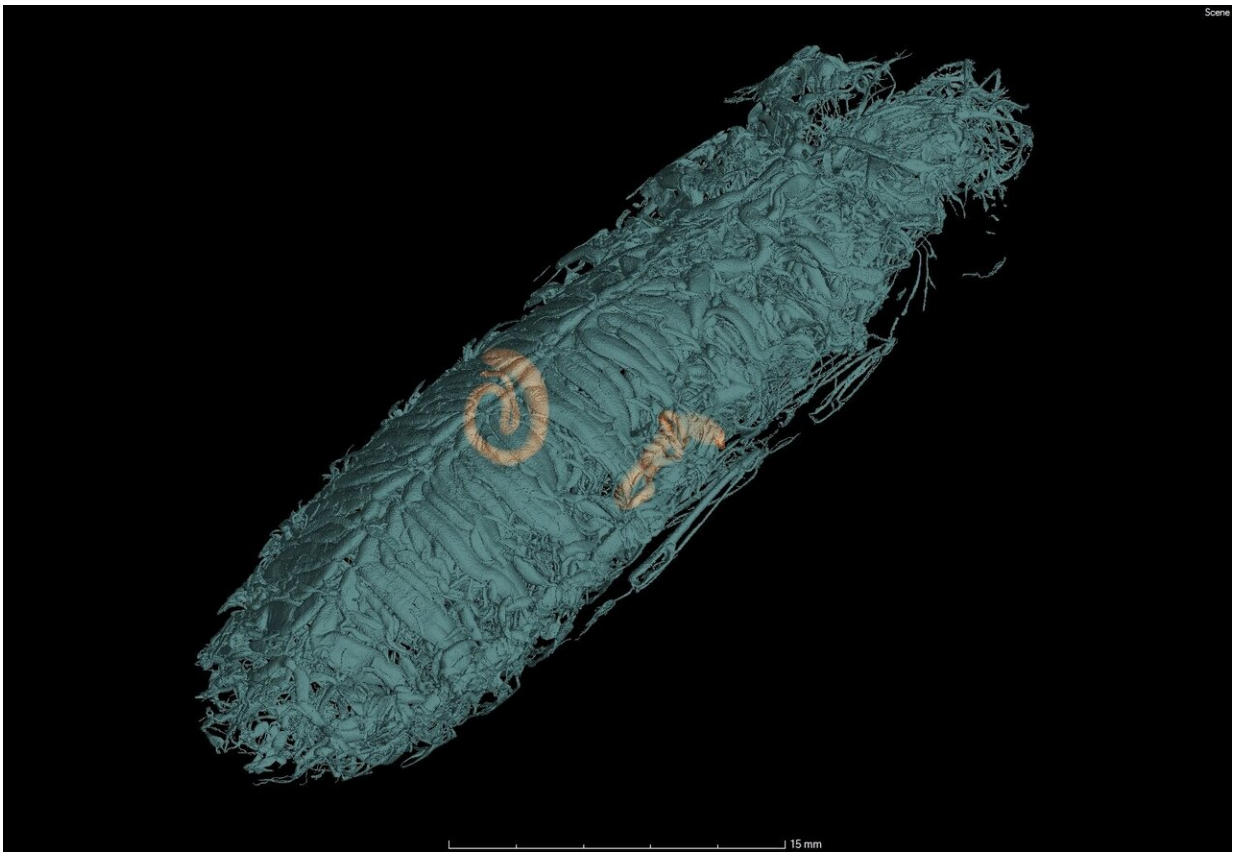
Encounters also involve 'low aggression' behavior including repeated approaches towards the opponent, which may retreat or adopt a low posture to guard against being overturned. During the laboratory contests, actions reflecting these dominant and submissive behaviors were scored for each animal.

A CT scan of each cockroach was then carried out allowing the researchers to study their whole body, including the size of their respiratory system.

Crucially, they found significant differences in the respiratory volumes of the cockroaches, and these were directly associated with their fighting prowess. The dominant individuals were found to have larger respiratory volumes compared to their similarly sized submissive opponents.

Dr. Sophie Mowles, Senior Lecturer in Animal and Environmental

Biology at Anglia Ruskin University (ARU), said: "When studying contest behavior it is important to consider not just the physical weaponry used by species, or the combative behaviors they employ, but also the underlying physiology that allows this energetically costly behavior to take place.



A CT scan of a male wide-horned hissing cockroach (Gromphadorhina oblongonota) showing the full respiratory volume. Highlighted are the sclerotized fourth spiracles, which these cockroaches use to produce their "hiss". Credit: Dr Sophie Mowles

"When visible differences are removed by size-matching opponents,

fights between male cockroaches are likely to escalate into trials of strength, and our study found that some cockroaches have much larger respiratory capacities than others, allowing them to dominate these contests. The increased ability to effectively deliver oxygen to their body tissue may enhance the fighting ability of these dominant males.

"Adaptations for prolonging aerobic respiration in these cockroaches have probably evolved as a way of maximizing oxygen exchange when burrowing through leaf litter, and we have shown that these adaptations also play a crucial role in physical contests between males, and therefore sexual selection."

More information: Sophie L. Mowles et al, Differential effects of aerobic capacities on fight outcome in giant hissing cockroaches, *Animal Behaviour* (2021). DOI: 10.1016/j.anbehav.2021.01.004

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