Horniest male beetles have the tiniest testicles

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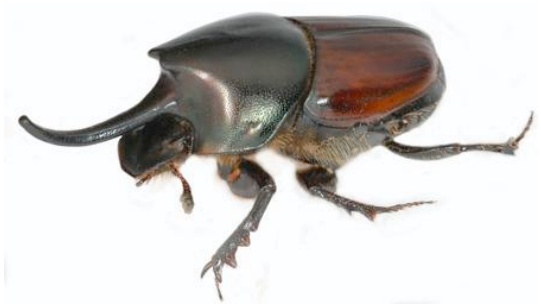
Dung beetle research may be about to boost the cliché about men with flashy sports cars. According to new study, male beetles with the most dramatic and ostentatious sets of horns apparently pay for that with smaller testicles.

The research is the first to experimentally demonstrate that investing energy in one mating advantage may come at the expense of another, the researchers claim.

Male dung beetles of the genus *Onthophagus* are noted for the size and diversity of their horns. In some species, these make up 40% of males' body length. These iridescent beetles use their flashy ornaments to battle against one another and block access to tunnels where they mate with females.



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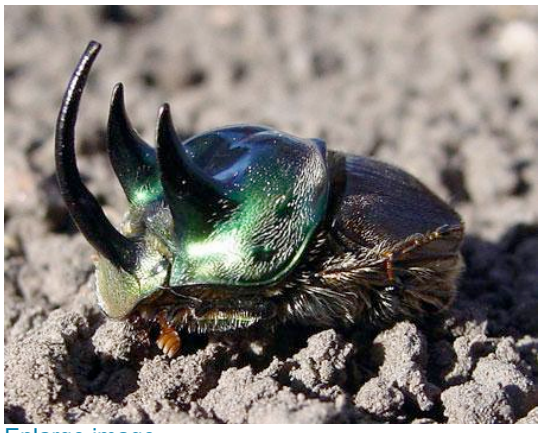
In the beetle *Onthophagus nigriventris* researchers have found a trade-off between testicle and horn size (Image: O Helmy and D Emlen)



Enlarge image
Onthophagus lanista is another species of dung-beetle endowed with impressive head gear (Image: E Greene)

The competition does not end there, however, as females often mate with more than one male. In these species, once inside the female, one male's sperm must compete with other males' sperm to fertilise eggs.

It is generally thought that the males that produce the most sperm are more likely to achieve a fertilisation so, besides the horns, testicle capacity is important in competition between males too, says Douglas Emlen, who led the research at the University of Montana in Missoula, US.

Stunted development

The problem is that in developing organisms there are limited resources available. Previous work has shown that horn size is negatively correlated to other traits such as eye, wing and antennae size.

To test the tussle that goes on between different sex-related structures, Emlen and colleague Leigh Simmons at the University of Western Australia in Crawley, experimentally stunted the development of horns in a brood of larvae of the species *Onthophagus nigriventris*. They did this by cauterising areas of cells on the surface of larvae that would otherwise have developed into horns.

The pair found that in comparison to a control brood of males which were allowed to develop normally, hornless males grew into larger adults with disproportionately large testes. In general, the pair found an inverse relationship between horn and testes size.

Energetic constraints

"This study is the first solid experimental demonstration that adaptations to compete for mates trade-off with what it takes to compete for fertilisations," says Scott Pitnick at Syracuse University in New York, US, who was not involved in the study.

"Because of energetic constraints, you really can't be good at all things," says Pitnick, who last year revealed a trade-off between relative brain and testes sizes in 300 different species of bat.

In a follow-up analysis, the researchers looked at 25 species of *Onthophagus* beetles. Between these other species, the researchers did not find an inverse relationship between horn and testicle size. They suggest that those species with the most dramatic horns were those that had developed an evolutionary strategy to buffer or protect the development of their testes.

The study also showed that in species where females mate with the most males – where sperm competition is at its fiercest – horns tend not to develop on the thorax. The thorax is closer to the testicles than the head, so a thorax horn might be more likely to divert precious resources from the testes during development, the researchers suggest.

"Trade-offs are fundamental to biology but they continue to surprise us, both in the forms they take, and in the myriad ways they can shape the evolution of organisms," says Emlen.

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