MSU experts study mystery of ornamental animals

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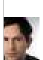
Lowering insulin levels reduces the size of beetle horns. Researchers from Michigan State University, the University of Montana and Washington State University looked into the hows and whys of large animal ornaments. / Courtesy of Michigan State University



Written by
Matthew Miller

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There is no firearms hunting season for Japanese rhinoceros beetles. Spectacular as their outsized horns can be relative to their pint-sized bodies, they're not the stuff of trophy mounts.

But those horns have more than a little in common with the antlers of the whitetail buck. They are signifiers of sex appeal to the female of the species, markers of health, measures of a creature's menace to other males.

And, according to a team of researchers from Michigan State University, the University of Montana and Washington State University, they might share a common mechanism that allows them to grow to exaggerated size.

The matter is broader than beetles and bucks.

Evolutionary biologists long have puzzled over the hows and whys of cartoonishly large animal ornaments: the tail of the peacock, the tumescent pincer claws of some crab species, supersized spreads of antlers.

"Looking these big extravagant traits, whether it's a peacock tail or the horns of these beetles, most people go, 'This is the most bizarre looking thing I've ever seen, how can it possibly function and do what it's doing?' " said Ian Dworkin, an MSU zoology professor.

In work with rhinoceros beetles, Dworkin and his collaborators have hit upon a possible explanation for why their horns and similar structures in other species can hit such exaggerated proportions and why a potential mate or a hunter can be confident that those antlers, tails, horns and claws are an honest advertisement of a creature's quality. The key is insulin.

Lots of food equates to lots of insulin, and scientists have recognized in recent years that insulin plays a determining role in how big an animal will grow.

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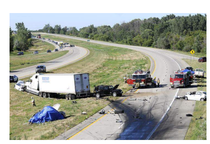

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The starting point for the research team — which included Doug Elmen at the University of Montana and Laura Lavine at Washington State University — was recognizing that some parts of the body are more sensitive to insulin than others.

As it turns out, the horn of the Japanese rhinoceros beetle is extremely sensitive to it.

The research team found a way to perturb the insulin pathway gene in beetle larvae. As they predicted, some body parts grew to normal size. The size of the horns were smaller by a sixth.

Page **1** 2 3 Next

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Site Map I Back to Top

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News
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(Page 2 of 3)

It's likely that the insulin pathway controlled the rate of growth of these structures long before they evolved into signals of health, menace and mate-ability, the team wrote in a paper published over the summer in the online edition of Science. If certain cells began evolving an increased sensitivity to insulin, it would have been an easy route to accelerated growth.

But the significance of the finding goes beyond mechanics.

One of the more influential theories about why a disobligingly large set of tail feathers or heavy and tangle-prone set of antlers came to be a mark of good health and good genes has to do with the very fact of their inconvenience.

'Handicap principle'

It's called the 'handicap principle,' and the idea, first put forward in the mid-1970s by the Israeli biologist Amotz Zahavi, is that only a strong and healthy animal could afford the costs of growing such unwieldy appendages and of living with them day to day. Fakers would have become a quick meal for predators or an easy target for rival males.

(It's possible, of course, that many hunters wouldn't mind a bit of faking in the big antler department, but they wouldn't have the same bragging rights. As Brent Rudolph, deer and elk program leader for the state Department of Natural Resources, likes to remind people, "They're trophies because they're rare.")

Striking variations

The beetle research, however, points to big horns, big tails, big antlers as signals that are intrinsically unfakable, directly tied to the actual fitness of the animal, and striking in their variation.

Smaller, weaker beetles have small horns. Larger, stronger ones will have horns that are ridiculously large.

"It doesn't seem to suggest anything related to a handicap," Dworkin said. "Instead, it suggests that these traits indicate something about the overall quality without having to provide a handicap."

As it happens, another recent project at MSU, one using bits and bytes instead of beetles, pointed in a similar direction.

Dworkin had a hand in that one too, along with computer science professor Charles Ofria and Christopher Chandler, a post-doctoral researcher at MSU's Bio/computational Evolution in Action Consortium who now teaches at the State University of New York at Oswego.

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Because nature doesn't offer many good opportunities to test the evolution of sexual displays and mating preferences — as Chandler noted, "If you wanted to get a really good lifetime fitness measurement for an organism, it's actually really, really hard to do," — the team turned to "digital organisms," strings of computer code that self-replicate, mutate and compete for resources (in this case, CPU cycles).

Measures of fitness

In this case, they also gave them the ability to grow the computer-code equivalent of buck antlers or peacock tails.

As predicted, the females chose the mostly flamboyantly ornamented males, and even when those ornaments initially had little to do with a male's fitness, they quickly evolved to be honest markers of quality.

But one of the benefits of the digital system is its mutability. Researchers can change the parameters, and the most surprising result came when they lowered the cost of growing outsized ornaments to essentially nothing, all but eliminating the handicap. Those ornaments still evolved to be a reliable gauge of a creature's fitness.

The antlers don't lie.

Page Previous 1 2 3