

Study finds genetic difference that determines head shape and feeding strategy in beetles

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Snail-eating slender beetle (*Carabus blaptoides fortunei*, left) and stout beetle (*Carabus blaptoides capito*, right). Slender beetles can eat snails by inserting their heads into the shells but cannot eat snails with shell apertures smaller than their heads. Conversely, stout beetles can eat small snails by crushing the shells but

cannot eat large snails with hard shells. Credit: Junji Konuma

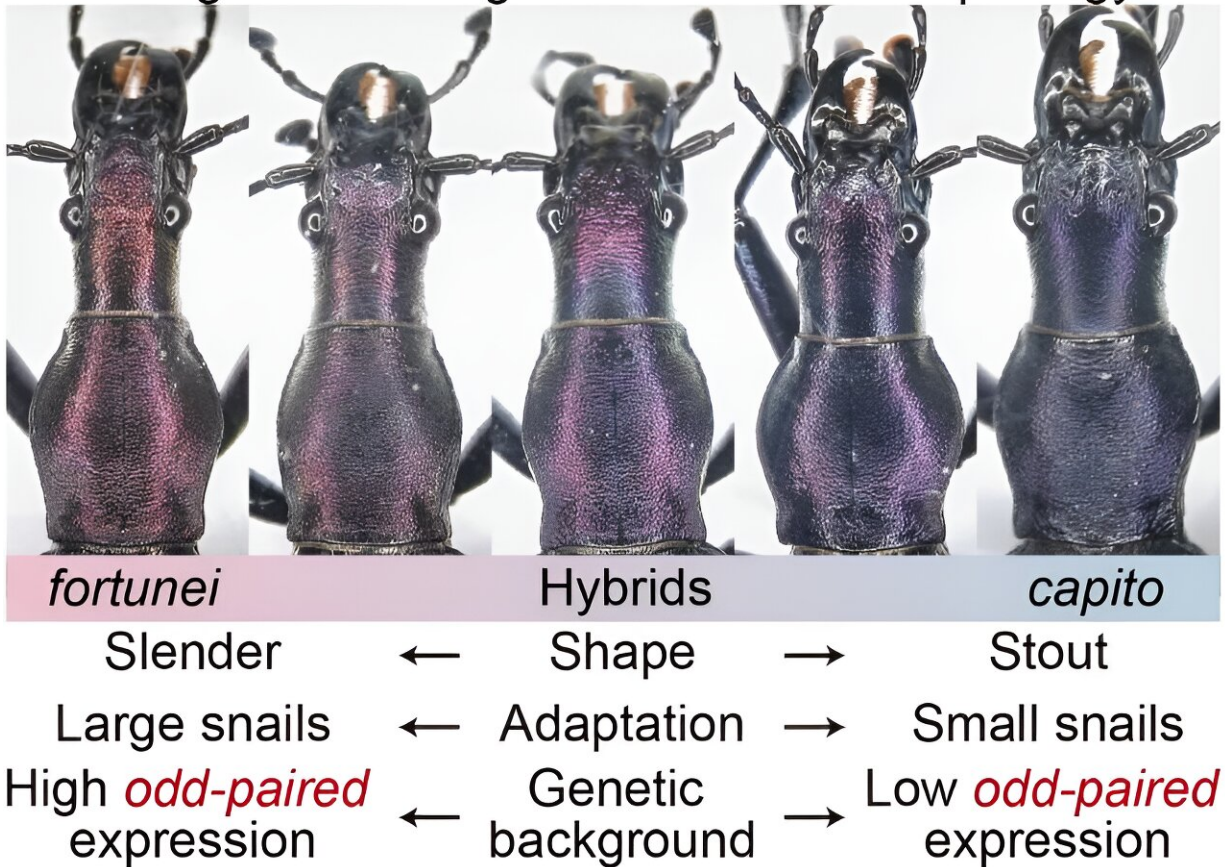
A research team led by Associate Professor Junji Konuma of Toho University and Professor Teiji Sota of Kyoto University has discovered the genetic background of the morphological variation in the snail-eating carabid beetle, *Carabus blaptoides*.

Through [whole genome sequencing](#) and [genetic analysis](#), the team identified the gene odd-paired (*opa*) as the key factor determining the beetle's head shape. High expression of *opa* results in a slender head, while low expression results in a stout head. This gene, which is conserved across a wide range of species—including insects, mollusks, and vertebrates such as humans—is known to influence head morphogenesis and is associated with congenital conditions in humans.

The discovery, recently [published](#) in the journal *Molecular Biology and Evolution*, underscores the significant role *opa* may play in the morphological diversity of beetles.

Morphological differences enable animals to adapt to diverse environments and contribute to [species diversity](#). Beetles, in particular, represent about one-fourth of all living species on Earth, with their remarkable adaptability leading to a diversification of morphology. However, the genetic mechanisms that drive such diverse morphological [evolution](#) remain largely unexplored.

The genetic background of beetle morphology



The genetic background of beetle morphology in *Carabus blaptoides*.. Credit: Junji Konuma

Carabid beetles that prey on [land snails](#) have diverged into slender and stout body forms. The slender type can insert its head into the shells of large snails but struggles with smaller ones. Conversely, the stout type, equipped with strong mandibles, can crush and consume snails by breaking their shells, yet its short, thick head is less effective for shell insertion. This trade-off between "inserting the head" and "breaking the shell" has driven the evolution of these two forms in snail-eating beetles—a phenomenon known as the "beetle's dilemma."

"Our study found that the opa gene is responsible for causing the beetle's dilemma," said Associate Professor Konuma from the Department of Biology at Toho University.

More information: Junji Konuma et al, Odd-Paired is Involved in Morphological Divergence of Snail-Feeding Beetles, *Molecular Biology and Evolution* (2024). [DOI: 10.1093/molbev/msae110](https://doi.org/10.1093/molbev/msae110)

Provided by Toho University

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