Genome-mapping reveals 'supermutation' resulting in cryptic coloration in stick insects

July 23 2020, by Mary-Ann Muffoletto, Utah State University

In a paper published July 23, 2020 in *Science*, researchers from Utah State University, the University of Sheffield, Paul Valéry University of Montpellier; the University of Bern, the Swiss Federal Institute for Aquatic Science and Technology, the Autonomous University of Querétaro, University of Notre Dame and the University of Nevada-Reno, discuss findings from an investigation of seven species of North American stick insects (Timema). Pictured is T. petita. Credit: Roman Villoutreix

Traits that form an organism's appearance, including color, are determined by many different genes and the creature's environment.

"Humans and domestic animals, for example, have varied skin, fur and hair, as well as a range of heights – an example of continuous variation," says Utah State University genetic ecologist Zach Gompert. "In the wild, however, types of genetic mutations affecting adaptation and thus, appearance, are only beginning to be understood. Some traits show more discontinuous or discrete variation."

In a paper published July 23, 2020 in *Science*, Gompert and colleagues from the University of Sheffield, United Kingdom; France's Paul Valéry University of Montpellier; the University of Bern and the Swiss Federal Institute for Aquatic Science and Technology, Switzerland; México's Campus Juriquilla of the Autonomous University of Querétaro, University of Notre Dame and the University of Nevada-Reno, discuss findings from an investigation of seven species of North American stick insects (*Timema*).

"Most research on the genetic basis of traits and adaptation has focused on individual genes and small mutations," says Gompert, associate professor in USU's Department of Biology and the USU Ecology Center "But in this paper, we uncover a greater role for large mutations and structural rearrangements of the genome that effectively 'lock up' suites of genes in groups."

The stick insects used in the study are flightless and plant-feeding. Most Timema species have green and brown-color "morphs," a local variety of a species, which are cryptic, meaning they visually blend into their surroundings. Cryptic coloration enables the insects to avoid predation by birds, as they blend in on the leaves and stems or bark of the plants they eat. However, one species, *Timema chumash,* exhibits a range of morph colors, including greens and browns, but also yellow, orange, red,

and shades of blue.

"Using genome-mapping methods, we show that a large, million base pair, adaptive deletion – a supermutation – converts a continuum of color variation seen in *T. chumash* into discrete color morphs in the other stick insect species," Gompert says. "This finding is important, as it helps reconcile large evolutionary shifts or gaps with the continuous process of evolution. It also provides insights into how continuous variation is packaged into semi-discrete units of biological diversity, such as morphs, sexes and species."

More information: Villoutreix, Romain, et al. "Large-scale mutation in the evolution of a gene complex for cryptic coloration," *Science*. 24 July 2020. DOI: 10.1126/science.aaz4351

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