Beetles' bright colors used for camouflage instead of warning off predators

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Yale-NUS College Postdoctoral Fellow Eunice Tan has discovered that the bright colour patterns of beetles are not a warning signal to predators as previously believed, but actually a form of camouflage, turning an old assumption on its head. Dr Tan, along with four collaborators from Australia and Spain, examined 51 species of Australian leaf beetles in their natural habitats, and discovered that each beetle's colour pattern is similar to the host plants that the beetle lives on, suggesting that those conspicuous colours help the beetle blend in with the plants it inhabits. The study was recently published as an open-access article in the peer-reviewed journal *Frontiers in Ecology and Evolution*.

As the first ecologist to examine the colour patterns of live leaf beetles in relation to their host plants, Dr Tan contextualised the colour patterns of beetles to their natural habitats, which allowed her to challenge the prevailing theory among coleopterists - scientists who study beetles - that the bright colours of leaf beetles developed as a deterrent signal to predators. These colourful markings were assumed to be a warning to predators against eating the beetles, which are able to secrete poisonous chemicals in self-defence. However, this idea was based on earlier studies, which focused on using museum collections of beetle specimens for their analyses. While this method affords researchers a large number of samples, the discolouration of deceased specimens made accurate colour analysis of the beetles impossible. Furthermore, such methodology also fails to take into account the colouration of each beetle's natural environment.

Dr Tan and her team spent 17 months photographing live beetles in 32 locations across four Australian states, in order to compare each beetle's colouration to the colour of the leaf it was found on. Taking into account the evolutionary relationship between the different beetle species, Dr Tan discovered that different species of beetles had colour patterns similar to those of their host plants. This suggests that the colourations have a camouflaging effect, rather than serving an aposematic (predator-deterring) function. This camouflage effect was particularly pronounced in beetles which fed on multiple types of plants, as they had to blend into many different environments.

"It was long thought that conspicuous colour patterns served to advertise the distastefulness of an organism to its predators. However, we have found that this cannot be the sole reason that conspicuous colour patterns developed in leaf beetles. In general, the beetles had colouration similar to that of their host plants, suggesting that there is natural selection at play and therefore some evolutionary advantage for these beetles to use camouflage as a defensive strategy against predators," shared Dr Tan.

Through her field studies, Dr Tan also observed the impact of ecological factors on the evolution of different beetle species' colouration patterns. Dr Tan's study found that both larger and smaller beetle species in her sample had similar levels of colour contrast against their backgrounds. However, the larger beetle species were more likely to be found in darker environments than their smaller cousins, suggesting that they were employing a hiding strategy against predators, despite having similar conspicuous colouration to their smaller cousins. An ecological property, the brightness of the environment, was therefore a potential factor influencing the evolution of beetle colouration.

Taken together, the findings of this study "point to a complex suite of factors driving natural selection, such as types of predators and host plant choice, which affect the evolution of colouration in leaf beetles",

said Dr Tan. Challenging the assumption that the sole explanation for bright coloration in leaf beetles is meant to ward off predators, Dr Tan postulated that the variety of anti-predator strategies in leaf beetles that she has found may explain their successful spread into a variety of habitats.

More information: Eunice J. Tan et al, The Role of Life-History and Ecology in the Evolution of Color Patterns in Australian Chrysomeline Beetles, *Frontiers in Ecology and Evolution* (2017). DOI: 10.3389/fevo.2017.00140

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