Too many forewing eyespots is bad for butterflies
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Monteiro from the NUS Department of Biological Sciences, found that the location of these eyespots is key to their protective function.

In their studies, the researchers found that variants of the bush brown butterfly which have more forewing eyespots suffered higher levels of predator attacks on these wings which are crucial for flight. This ultimately led to increased rates of successful predation, causing a decline in their population. The team also discovered that this variant laid fewer eggs due to its faster demise, and thereby had lower fitness, in evolutionary terms, than those with less forewing eyespots.

The findings were first published in the journal Proceedings of the Royal Society B on 26 May 2021.

Observing predator behavior

In a set of predation experiments, the research team observed the behavior of mantids in attacking two variants of bush brown butterflies with differing forewing eyespot numbers. Butterflies in the first group each had two forewing eyespots, while those in the other group had four. The results showed that the butterflies with two additional eyespots in the second group experienced more intense attacks to their forewings, in addition to the typical attacks on the hindwings.

"Butterflies can cope with damaged hindwings, but their forewings are critical for all stages of flight, from general flight to evasive maneuvering. With more forewing damage, these butterflies are less likely to escape attacks and, even if they do, they would struggle to survive future attacks. From this experiment, it is clear the forewing with more eyespots becomes a more important target for predators," explained Dr. Ian Chan, Research Fellow with the NUS Department of Biological Sciences, who was part of the research team.

Many butterfly species bear distinct circular markings known as eyespots on their wings, and the functions of these rings of contrasting colors vary. A long-standing theory is that they serve as anti-predator defenses—small eyespots along the wing margin can protect butterflies by directing predators to attack less important parts of the body, such as the hindwings, enabling them to escape.

Most nymphalid family butterflies have half as many eyespots on their forewings compared to their hindwings. In particular, this has been observed in the bush brown butterfly Bicyclus anynana.

Recent research by biologists from the National University of Singapore (NUS) sought to understand the impact of uneven distribution of eyespots. The team, led by Professor Antónia Monteiro, found that the location of these eyespots is key to their protective function.
To demonstrate the effects of the mantids' attacks on the butterflies, the researchers looked into three indicators of the butterflies' fitness: the amount of wing damage they suffered, the number of eggs laid, and lifespan. The team found that when compared to butterflies with fewer forewing eyespots, those with more eyespots received more damage to their forewings, laid fewer eggs, and had shorter lifespans.

Uncovering the mysteries of eyespot patterns

"Our findings demonstrate how the location of eyespots on butterfly wings both influences and is influenced by the behavior of their predators, revealing more of the complexity behind how animals communicate to one another. Such a discovery raises further questions about why some species of butterflies have the opposite pattern, carrying more forewing than hindwing eyespots instead," said Professor Monteiro.

To deepen their understanding, the NUS researchers are looking to investigate whole predator-prey communities to uncover further drivers of eyespot number diversity in butterflies.


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