Scientists discover how the Diadem butterfly mimics the African Queen

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The female Diadem (bottom left) mimics the African Queen (top left). The male Diadem (right) keeps a distinct pattern to attract mates. Credit: University of Edinburgh

Scientists have discovered how female Diadem butterflies have evolved to look like African Queen butterflies to repel predators.

African Queens are toxic, making them poor food for predators such as

birds. Diadems are actually good prey for birds—but they have evolved colors and patterns that closely match those of African Queens, making them appear toxic.

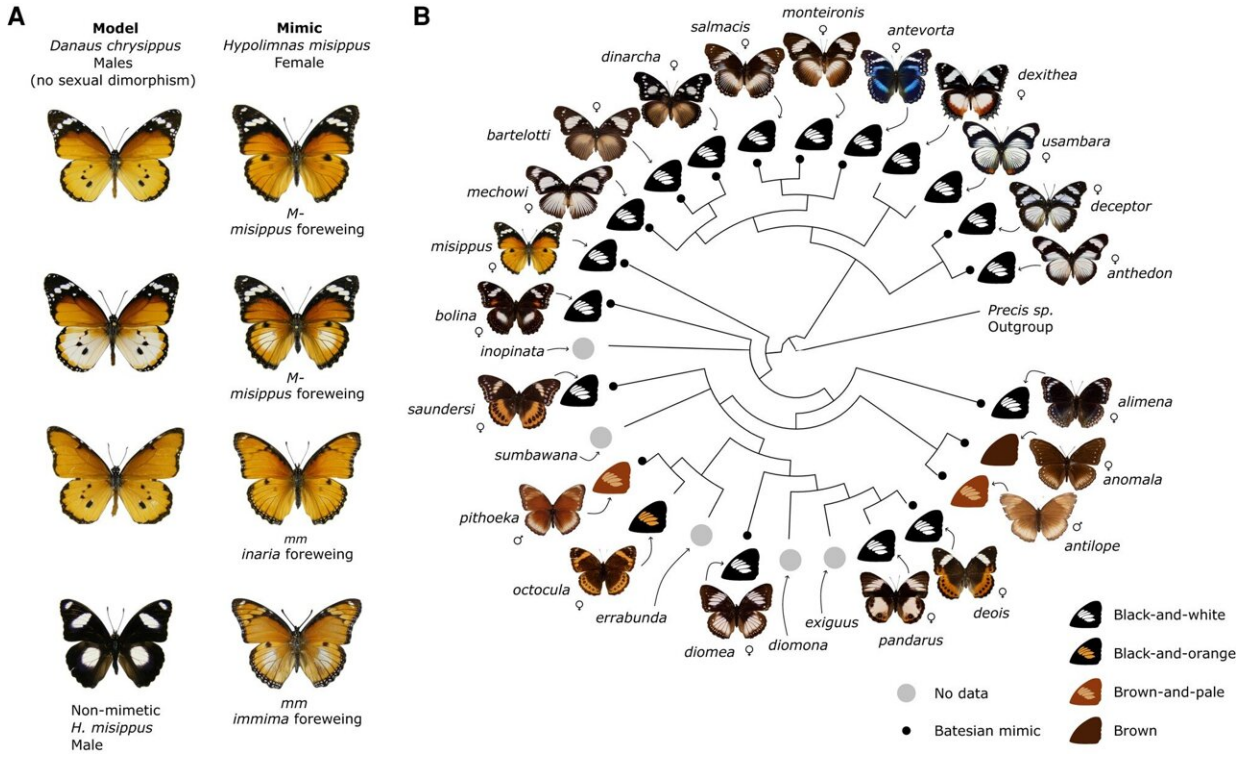
The new study—by a team including the universities of Exeter, Edinburgh and Cambridge, and Mpala Research Centre in Kenya—found that, surprisingly, different genes control these patterns in the two species.

"Since the time of Darwin, Wallace, and Bates, people have wondered how different butterflies have evolved to appear the same—and now we know," said Professor Richard French-Constant from the Centre for Ecology and Conservation on Exeter's Penryn Campus in Cornwall.

"Our findings present a compelling instance of convergent evolution, whereby species independently evolve similar traits."

"We also find evidence of adaptive atavism in the Diadem—when a species reverts to a state found in its ancestors."

"In this case, Diadem butterflies have re-evolved an ancestral wing pattern and repurposed it to mimic the Africa Queen, providing a major advance in our understanding of how tasty species mimic those that are toxic."



Mimicry in Hypolimnas missippus and the Hypolimnas genus. A) Female morphs of H. misippus side by side with their matching model morphs of D. chrysippus. Names of the forewing morph of H. misippus are specified below each photo. Although morphs matching the bottom-right H. misippus (immima forewing and white-spotted hindwing) exist within the D. chrysippus hybrid zone, they are considered maladaptive intermediates outside of it. D. chrysippus is not sexually dimorphic; individuals shown are all males. Non-mimetic H. misippus male at the bottom. B) Phylogram of the Hypolimnas genus extracted from Sahoo et al. (2018) (concatenated Bayesian inference tree) showing that black-and-white forewing tips are common through the genus and most likely ancestral. For presentation purposes, one specimen is shown per species, although not all species are monophyletic. Choosing other specimens would not change the conclusion on the ancestrality of black-and-white wing tips. All species shown are sexually dimorphic and/or polymorphic except antevorta, dexithea, inopinata, and usambara. Species showing Batesian mimicry are indicated by a small dark dot. Recurrent forewing phenotypes are indicated by wing drawings. Male and female signs indicate the sex of the individual photographed. Butterfly photos are reproduced from Moore (2023) under CC-BY. Credit: *Molecular Biology and Evolution* (2024). DOI:

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Different patterns are found on African Queen butterflies in north, east, south, and west Africa—and the patterns on female Diadem butterflies in each area match these.

In contrast, male Diadems have distinctive dark wings with large white patches—possibly because the need to be recognized by the female outweighs the need to hide.

"This is amazing, as the males and females look like totally different butterflies, even though they share the same genome," said Dr. Dino Martins, who was the director of Mpala at the time all the butterflies were collected.

The study used "haplotagging," a linked-read sequencing technology, and a new analytical tool called Wrath to study the genomes of multiple butterflies from the two different species.

"These new techniques can give us unique insights into the molecular population genetics of this fascinating example of Batesian mimicry," said Dr. Simon Martin, from the University of Edinburgh, one of the co-authors on the study.

The paper, published in the journal *Molecular Biology and Evolution*, is entitled, "Transposable element insertions are associated with Batesian mimicry in the pantropical butterfly Hypolimnas misippus."

More information: Anna Orteu et al, Transposable Element Insertions

Are Associated with Batesian Mimicry in the Pantropical Butterfly Hypolimnas misippus, *Molecular Biology and Evolution* (2024). DOI: 10.1093/molbev/msae041