

Some like it hot: Moth and butterfly species respond differently to climate change

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Morpho didius – Museum specimen. Credit: Wikipedia

New research led by ecologists at the University of York shows that certain species of moths and butterflies are becoming more common, and others rarer, as species differ in how they respond to climate change.

Collaborating with the Natural Environment Research Council's Centre

for Ecology and Hydrology, the charity Butterfly Conservation, the University of Reading and Rothamsted Research, scientists analysed how the abundance and distribution of 155 [species](#) of British butterflies and moths have changed since the 1970s.

Using data collected by thousands of volunteers through 'citizen science' schemes, responses to recent climate change were seen to vary greatly from species to species.

Published in *Science Advances*, this research shows variation among species is attributed to differing sensitivity to climate change, and also because species vary in how much the climate has changed for them (their 'exposure').

Sensitivity is a measure of how much species' numbers change as a result of year-to-year changes in the weather - each species is sensitive to different aspects of the climate, such as winter temperature or summer rainfall. Variation in how much the climate they are sensitive to has changed for them - their 'exposure' - is also a contributing factor in their varied responses.

Results show that species such as the treble brown spot moth (*Idaea trigeminata*) and the speckled wood butterfly (*Pararge aegeria*) which are sensitive to climate, and for which the climate has improved the most, have experienced the greatest increases in their distribution size and abundance.

Conversely, other species, such as the grizzled skipper butterfly (*Pyrgus malvae*), the September thorn moth (*Ennomos erosaria*) and the mouse moth (*Amphipyra tragopoginis*), have experienced deteriorating climates resulting in declines in abundance and distribution size.

Georgina Palmer, Lead author and Research Associate in the University

of York's Department of Biology, said: "Species are sensitive to different aspects of the climate, which results in species being exposed to different levels of climate change. Nearly two-thirds of the changes in abundance can be explained by these species-specific differences. This means that their responses to climate change may be more predictable than previously recognised."

Dr Tom Oliver, Co-author and Associate Professor in Landscape Ecology at the University of Reading, said: "Climate appears to have a key role in determining the distributions and abundances of species. Our next steps will be to determine the role of habitat availability in influencing species responses as the climate changes."

Dr Jason Chapman, Co-author at Rothamsted Research, said: "This study utilises large amounts of long-running data collected by volunteers through schemes such as the Rothamsted Insect Survey, run by Rothamsted Research, and the UK Butterfly Monitoring Scheme, run by Butterfly Conservation. Such data is a valuable resource to scientists, allowing us to describe the changes in distribution and abundance of species and to understand why these changes are taking place."

Richard Fox, Head of Recording at Butterfly Conservation, said: "Butterflies and moths provide important ecosystem services such as prey for insectivorous birds, as well as being an important part of our natural heritage. These species have also long been used to study the health of ecosystems, as indicators of biodiversity.

"This research allows us to identify species likely to respond favourably to climate change, as well as those which are vulnerable to climate change. The results are surprising and significant as conservationists had assumed that most butterflies and moths in cool, rainy Britain would benefit from climate change, at least in the short term. However, this research suggests many are already declining due to the changing

climate."

Professor Jane Hill, Co-author and Professor of Ecology and Evolution at the University of York, said: "We know that the distributions and abundances of species are affected by climate, and unless we take action to minimise climate change, for example by reducing emissions, these impacts will continue. Our study allows us to target conservation efforts on those species that are most negatively affected by climate, to help them persist under future [climate change](#)."

Professor Chris Thomas, in the University of York's Department of Biology, added: "The great puzzle has been why some species of moth and butterflies have been increasing and spreading, whilst others have declined in the last 40 years. Now we know that most of the differences arise because each species responds in a different way to the climate. Some like it hot, some like it cold. Some like it hot in winter but not in summer. Some like it wet in spring, others dry in the autumn.

"It turns out that these 155 different species of [butterflies](#) and moth have almost 155 different 'opinions' on how much the climate has changed, and whether it has got better or worse. Climate change is causing massive alterations to our wildlife."

More information: Individualistic sensitivities and exposure to climate change explain variation in species' distribution and abundance changes, *Science Advances*, [DOI: 10.1126/sciadv.1400220](https://doi.org/10.1126/sciadv.1400220)

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