Britain's butterflies are getting bigger as the climate changes

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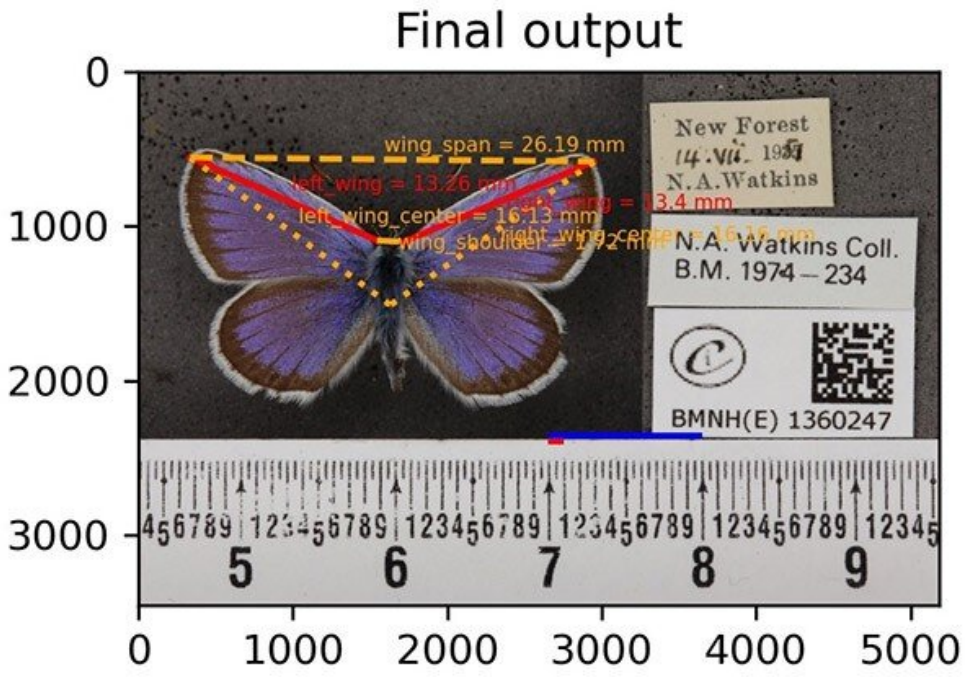

Example Mothra output image (male Plebejus argus). Credit: University of Southampton

New research using computer vision to analyze tens of thousands of butterfly specimens in the Natural History Museum's collection has found that some British butterflies are getting bigger in response to climate change.

An international team from London's Natural History Museum, the University of Southampton and the Berkeley Institute for Data Science at the University of California have used the Natural History Museum's digitized butterfly collections to evaluate the impact of climate change on British butterfly species size. The most common findings suggest that adult butterfly body size increase with temperature during the late larval stages of development.

The research, published in *Methods in Ecology and Evolution*, was conducted on one of the largest butterfly collections in the world at the Natural History Museum which has approximately 125,000 specimens.

Digitisation of these species has helped scientific research into the impact of climate change on wild species.

Dr. Philip Fenburg, Lecturer in Marine Biology at the University of Southampton who co-authorered the study said, "museums across the world are rapidly digitizing their collections and making them freely available to researchers and the public. At the same time, there have been great advances in computer vision technology which allows automated recognition, detection and measurement of features in digital images."

"Our paper is among the first to show that computer vision can be applied to these digital images for testing theories on how animals may respond to climate change. In our case, we test how the body sizes of British butterflies change with warming temperatures. Computer vision has the potential to rapidly advance the research utility of digital natural history collections and accelerate their usage for understanding how the biosphere will react to climate change."

Researchers at the Berkeley Institute for Data Science developed a computer vision pipeline called 'Mothra' and with this, they were able to

analyze specimens from the Natural History Museum's iCollections project. The oldest specimen used in this project dates from the early 1900s. Mothra automatically detects the specimen and measures characteristics including wing features, orientation (how the specimen is pinned) and identifies the sex. This process substantially reduces the time required to analyze individual specimens, which would otherwise require researchers to physically measure and record manually. Results from this study indicated that there was a near perfect relationship between Mothra and manual measurements.

"The Natural History Museum's British and Irish butterfly and moth collection is the oldest, largest, and most diverse of its kind in the world." Says, Geoff Martin, Senior Curator in Charge (Lepidoptera) at the Natural History Museum London. The Natural History Museum has so far digitized over five million specimens and released these openly, including over 776,000 butterflies and moths.

Scientists paired measurements with monthly temperature records experienced by the immature stages of 24 different British butterfly species and looked for patterns in the relationship between size and temperature. Both the Natural History Museum's collections and temperature records span many decades and provide a large amount of data, making them ideal sources for temperature-size response studies.

They found that for 17 of these 24 species, the adult butterfly size increased as the temperature increased during late larval stage.

Stephen J Brooks, Entomology Researcher at the Natural History Museum London and co-author on the paper said, "natural history collections contain information on how the natural world responds to change through time. But the sheer size of these collections often makes it difficult to extract this information. Our study has shown the value and power of digitization and machine learning to rapidly release this wealth

of evidence, which can be used to conserve species in a changing world."

More information: Rebecca J. Wilson et al, Applying computer vision to digitised natural history collections for climate change research: Temperature-size responses in British butterflies, *Methods in Ecology and Evolution* (2022). DOI: 10.1111/2041-210X.13844

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