First study to link earlier butterfly emergence with climate change

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Butterflies are emerging in spring over 10 days earlier than they did 65 years ago, a shift that has been linked to regional human-induced climate change in a University of Melbourne- led study. The work reveals for the first time, a causal link between increasing greenhouse gases, regional warming and the change in timing of a natural event.

The study found that over a 65 year period, the mean emergence date for adults of the Common Brown butterfly (*Heteronympha merope*) has shifted 1.6 days earlier per decade in Melbourne, Australia. The findings are unique because the early emergence is causally linked with a simultaneous increase in air temperatures around Melbourne of approximately 0.14°C per decade, and this warming is shown to be human-induced (anthropogenic).

Lead author of the study Dr Michael Kearney from the Department of Zoology, University of Melbourne says the findings could help our ability to forecast future impacts of climate change on biodiversity.

"Shifts in these seasonal life cycle events represent a challenge to species, altering the food and competition present at the time of hatching. Studies such as ours will allow better forecasting of these shifts and help us understand more about their consequences," says Dr Kearney.

The butterfly emergence work was conducted by Dr Kearney and PhD student Natalie Briscoe. Professor David Karoly from the School of

Earth Sciences, University of Melbourne contributed the climate modeling work. Co-authors include Dr Warren Porter (University of Wisconsin) and Drs Melanie Norgate and Paul Sunnucks from Monash University. The study was funded by an Australian Research Council grant to Monash, Melbourne and Wisconsin Universities.

The study will be published in *Biology Letters*, a prestigious international journal of the Royal Society.

The team raised caterpillars of the Common Brown Butterfly in the laboratory to measure the physiological impact of temperature on its rate of development. They used this information to model the effect of observed historical climate trends in Melbourne on the speed of the butterfly's development. They combined this with global climate model outputs for the Melbourne area over the same period to examine whether natural climate variability or human influence on climate was more likely to have caused the air temperature change seen in Melbourne.

"Scientists have previously observed that biological events are happening progressively earlier in spring over the past few decades. This new work has tied the earlier emergence of butterflies directly to a regional temperature increase, and has tied the temperature increase very strongly to increases in greenhouse gas concentrations caused by humans," says Professor Karoly.

Provided by University of Melbourne