Climate change

Engela Duvenage reports on the implications for Africa's moths and butterflies

In coming decades, shifts in temperature regimes and rainfall patterns due to climate change will significantly influence where and in what numbers African species of moths and butterflies are to be found. This is according to a study completed at the Department of Conservation Ecology and Entomology at Stellenbosch University (SU), published in the journal *Ecological Modelling*. It shows that some species found in more temperate regions might experience a huge reduction in areas in which they can survive.

The paper puts forward a new process-based model that other researchers studying the effects of climatic changes on African butterflies and moths can readily use. The study was conducted while the lead author, Dr Madeleine Barton, was a postdoctoral researcher based in the department; she has since returned to Australia, where she is employed as a research scientist at the CSIRO. Her co-authors were the department's Professor John Terblanche and a former SU 'postdoc', Professor Brent Sinclair, who is now with the Department of Biology at Western University in Ontario, Canada.

"Compared to other regions of the world, we still know very little about how African species of Lepidoptera (which includes butterflies and moths) will respond to climate change," notes Prof. Terblanche, whose research focuses on the impact that climate change has on the distribution and population lifecycles of agricultural pests and disease-carrying insects such as tsetse flies. "The study of insects is important, because the agricultural sector is worried about how climatic changes will affect the distribution of known insect pests and others that pollinate crops. Ultimately, it influences our food security. Many insect species also carry diseases, and an expansion in their abundance or geographic range could have health implications for people."

According to Prof. Terblanche, the process-based climatic prediction model that Dr Barton developed is the first climatic model specifically designed to incorporate how rainfall might interact with temperature to make more realistic predictions about the future of African butterflies and moths. Similar models have been developed for species from other regions of the world, such as Europe, North America and Asia. Dr Barton's model is open source and free to use by other scientists who have data available on the physiology and distribution of African species.

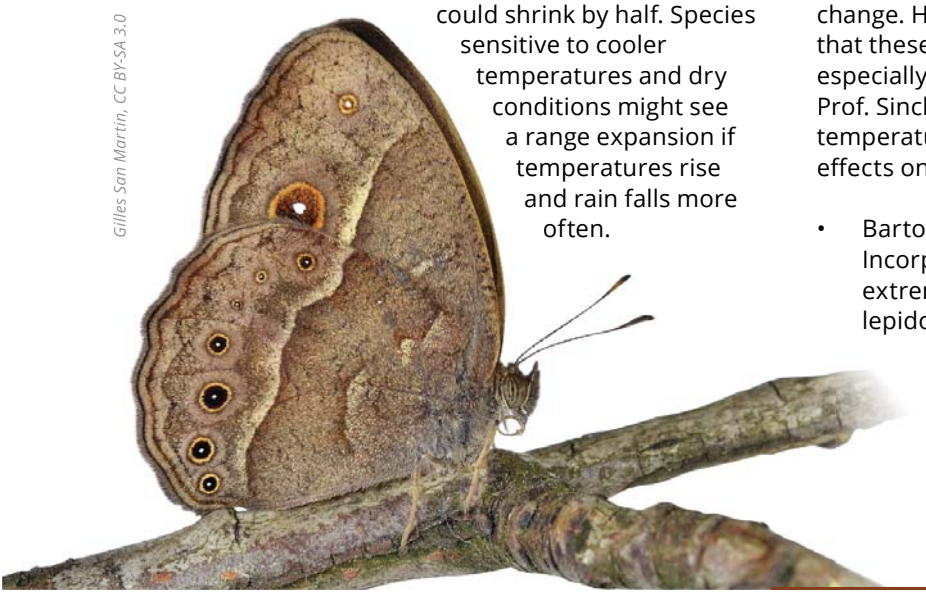
Dr Barton's model not only considers possible future temperature changes, but also the impact that changing rainfall patterns and droughts could have on insects. It was tested under current climatic conditions, as well as those predicted by the year 2050. The model was also put through its paces using data about the physiology and sensitivity to temperature and water availability of two endemic African species: *Busseola fusca* is a widespread agricultural pest affecting food security, while *Bicyclus anynana* is a well-studied butterfly.

"For more accurate predictions, it is better to include temperature changes along with the availability of water, because these elements influence the survival of species in different ways. The distribution and population performance of an insect across the continent under climate change will depend on its physiological ability to tolerate specific conditions," explains Dr Barton.

Ukushintsha kwesimo sezulu kuzothikameza ukusabalala nobuningi bezinhlobo ezahlukene zezimvemvane. Lokhu kungaba izindaba ezinhle kuba limi, ngoba ezinye zalezimvemvane zecekela phansi izitshalo. Noma kunjalo, ezinye izinambuzane zizoyithatha indayo yalezimvemvane, ziqhubeke zicekele phansi lezizitshalo.

Translation by Zamantimande Kunene

The researchers found that higher temperatures and changing rainfall patterns could decrease the distribution of certain African butterfly and moth species currently widely occurring across the continent by up to 72%. The range of species of others that cannot withstand higher temperatures, such as the potentially damaging maize stem borer *(Chilo partellus)*, could shrink by half. Species sensitive to cooler temperatures and dry conditions might see a range expansion if temperatures rise and rain falls more often.



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Species in the northern parts of Africa are predicted to move towards coastal and higher-lying areas to escape the evolving harsh climates, while the range of those in the southern parts of Africa are likely to shrink.

"When we look only at temperature, it seems that species in the tropics are most sensitive to climate change. However, when using our models, it shows that these impacts also extend to temperate regions, especially when precipitation patterns change," explains Prof. Sinclair. "These interactions between extreme temperatures and drought in the future could have big effects on insects in Africa and elsewhere."

- Barton, MG, Terblanche, JS & Sinclair, BJ 2019. Incorporating temperature and precipitation extremes into process-based models of African lepidoptera changes the predicted distribution under climate change. *Ecological Modelling* 394: 53-65. DOI:10.1016/j.ecolmodel.2018.12.017

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