Size is key to understanding the impact of climate change on disease vectors

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Vector-borne diseases are those passed on to humans via an intermediary, a common example being mosquitoes passing on malaria.

A new international study published in *Global Change Biology* and led by

Monash University researchers has found that models of disease vectors, such as mosquitoes, are likely to overestimate the effects of future climate.

"Climate change, invasions and vector control strategies all alter the distribution and abundance of mosquitoes," said lead study author Dr. Louise S. Nørgaard, from the Monash University School of Biological Sciences, and the Centre for Geometric Biology.

"When disease vectors undergo range shift, so do disease burdens," she said.

"Predicting such shifts is a priority to adequately prepare for disease control."

Models of population responses to climate change incorporate a range of measures including body size and reproductive output but both are particularly difficult to measure directly in mosquito populations. Instead researchers traditionally rely on the relationship between wing length, which is easier to measure, and reproductive output.

Underlying most models of mosquito distributions is the assumption that there is a directly proportional relationship between wing length and reproductive output, or in other words, wing length and reproductive output increase at the same rate.

But the work by the Monash team challenges those assumptions—after analyzing a large amount of existing data, they found that it wasn't true for most mosquito species.

The study found that larger female mosquitoes contributed disproportionately more to the replenishment of the population, so it is not a linear relationship.

When the scientists factored in this non-linear relationship, they also found that smaller females were contributing more to population replenishment than was assumed in current models.

"This is important because increasing temperatures result in smaller females," said Dr. Nørgaard.

"So, temperatures where populations have been considered unviable, will, in fact, persist" she said.

In the fight against Dengue fever, mosquitoes that carry a bacteria called Wolbachia are bred in the lab and released into the wild to reduce the transmission of the dengue virus.

Females released from the lab are bigger than their wild counterparts and will contribute disproportionately more to the population when they breed.

"For this aspect of disease control it is likely we are underestimating the impact of releasing Wolbachia-infected mosquitoes in the fight against disease," said Dr. Nørgaard.

The authors concluded that to predict the response of disease vectors like mosquitoes to global change we need to better represent the relationship between size and reproductive output.

More information: Louise S. Nørgaard et al, Predicting the response of disease vectors to global change: The importance of allometric scaling, *Global Change Biology* (2021). DOI: 10.1111/gcb.15950

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