

## **Burak Bulut**

Senckenberg Biodiversity and Climate Research Centre,  
Frankfurt am Main, Germany

# **A Matter of Time and Temperature**

## **Disentangling the Mechanisms of Oxidative Stress and Germline Mutation in *Chironomus riparius***

Thermal extremes are known to impose significant stress on ectotherms. While the physiological consequences of high temperatures are well-documented and often linked to metabolic rate, the mechanisms driving stress and damage on the cold side of the thermal spectrum remain a puzzle. This is particularly true when high mutation rates are observed in cold conditions where oxidative stress is not correspondingly elevated.

In this presentation, I will first address this by presenting our direct in vivo measurements of reactive oxygen species (ROS) production across a wide, ecologically relevant temperature gradient in *Chironomus riparius*. These results reveal that cold and heat stress are mechanistically distinct, challenging the notion of a single, unified stress response. I will then



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use these findings to focus on the paradox of cold-induced mutation. To disentangle the effects of direct thermal stress from time-dependent factors, I will present experimental results that isolate the influence of generation length on the germline mutation rate. This evidence will demonstrate that the duration of the maturation period, independent of temperature, is a critical driver of mutation accumulation, thereby solving a key piece of the thermal stress puzzle.