Climate change causes warmer and more variable temperatures globally, impacting physiological rates and function in ectothermic animals. Acclimation of physiological rates can help maintain function. However, it is unresolved how variance in physiological rates changes with temperature despite its potential ecological and evolutionary importance.

We developed new effect sizes that capture how both the mean and variation in physiological rates change across temperature (based on the temperature coefficient, Q10), and used them to test how acclimation and acute thermal responses vary across aquatic and terrestrial ectotherms using meta-analysis (>1900 effects from 226 species). Comparing both the magnitude of acclimation and changes in variation side-by-side provides unique opportunities for evaluating the importance of plasticity and selection under climate change.

We show that variance in physiological rates increases at higher temperatures, but that the magnitude of change depends on habitat. Freshwater and marine ectotherms are capable of acclimation and have the greatest increase in variance. In contrast, terrestrial ectotherms have reduced acclimation abilities and smaller increases in physiological rate variance. Simulations suggest that these patterns may result from differences in among-individual variation in thermal breadth and optima of performance curves across habitats.

Our results highlight the greater vulnerability of terrestrial ectotherms to climate change because of both a lack of acclimation capacity and a limited increase in variance that may provide less raw material for evolutionary adaptation. Considering both acclimation capacity and variance in physiological rates side-by-side is therefore important for understanding how climate change will impact populations.