



Adaptation of seed beetles to fluctuating temperatures

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Climate change and its projected environmental impacts are expected to lead to widespread quantitative genetic variation. However, the impacts of climate change on biological systems are notoriously difficult to measure, highlighting the need for controlled laboratory experiments. We examined long-term effects of novel fluctuating daily temperatures on lifetime reproductive success, body mass, and development time in laboratory populations of the seed beetle (*Callosobruchus maculatus*). Most experimental studies of adaptation to thermal stress test populations at constant temperatures, or they make incremental changes to an otherwise constant mean background state. These conditions are not realistic, since environmental changes fluctuate in time, and these fluctuations are superimposed on preexisting background variability, significantly influencing how populations respond to external drivers. To address this, we investigated the evolutionary impact of a switch from a constant 29 degrees to a more realistic sinusoidal daily temperature cycle fluctuating around a mean of 33 degrees, representative of a May day in central India where this species evolved. Over 19 generations, two replicates of two different stock populations of beetles were kept under both sets of conditions. Before conducting assays we split each of the 8 populations in two, keeping one set in its original environment and allowing the other set to acclimatize for two generations (without selection) to the other environment, to control for parental effects. As expected the response to realistic environmental change had a strong and quantifiable plastic component. Relative to beetles that evolved at 29 degrees, beetles that evolved in fluctuating temperatures were larger in that environment but smaller when raised at 29 degrees. These beetles had higher reproductive success when raised at 29 degrees, but lower reproductive success at the fluctuating temperatures to which they'd presumably adapted. Contrary to results of similar studies, climatic fluctuations did not appear to affect the sexes differently.