Interactive effects of multigenerational temperature exposure and heat waves on physiological responses to acute heat stress.

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Résumé

Climate change, which mainly manifests as the increase in mean temperatures and in the frequency of extreme climatic events, can strongly affect individuals, populations and communities. In particular, increasing temperature can greatly affect ectotherm organisms through the modification of several physiological and metabolic processes. However, some organisms are capable of resistance, acclimation or adaptation to increasing temperatures, which can potentially buffer the impacts of climate change on their fitness. Investigating these buffering mechanisms and their limits can help understand and predict the impacts of climate change on species survival and thus on biodiversity. While the phenotypic responses of ectotherms to long-term warming and their short-term responses to acute heat stress are better understood, the potential interactive effects of those two phenomenon remains largely unexplored. Here, we investigated the potential interactive effects of long-term high temperatures and heat waves on the critical upper thermal limits (CTmax) of the Medaka fish (*Orizias Latipes*). We aimed at determining (1) how multigenerational exposure to warm temperatures can affect the CTmax, (2) if an exposure to a heat wave could increase the CTmax, and (3) if multigenerational exposure to high temperatures and heat waves can have interacting effects on the CTmax. To this aim, Medaka fish were maintained for multiple generations in cold (20∘C) and warm (30∘C) waters. Fish CTmax of both temperature lineages were measured, and fish from the next generation were then placed in a common garden from birth to several months. Half of the common garden fish were exposed to a heat wave, with an assessment of fish body condition before, during and after the heat wave. Finally, CTmax of fish from both temperature lineage, exposed or not to a heat wave, were measured. Our results showed that the two lineages had distinct responses to heat stress with an increase in CTmax of 4∘C after multigenerational exposure to warmer conditions. In addition, fish exposed to a heat wave also had a higher CTmax. Finally, we found an interactive effect between long-term exposure to high temperature and heat wave on the CTmax. Our results highlight the need to consider both long-term and short-term exposure to temperature to determine species thermal tolerance.

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Mots-Clés: Climat change, Heat wave, CTmax, Fish