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Long-term and acute effects of temperature and oxygen on metabolism, food intake, growth and heat tolerance in a freshwater gastropod

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Abstract

Temperature affects the physiology and life-history of ectothermic animals, often increasing metabolic rate and decreasing body size. Oxygen limitation has been put forward as a mechanism to explain thermal responses of body size and the ability to survive stress. However the time-scales involved in growth performance and heat tolerance differ radically. In order to increase our understanding of oxygen and temperature effects on body size and heat tolerance and the time scale involved, we reared *Lymnaea stagnalis* under six combinations of temperature and oxygen tension from hatching up to an age of 300 days and recorded shell length during this whole period. At the end of this period, we determined scope for growth by measuring food intake rate, assimilation efficiency, respiration rate and ammonium excretion rate at two different temperatures. We also measured the snails' ability to survive heat stress (CTmax), both at normoxia and hypoxia. We found that scope for growth and long term growth performance were much more affected by interactions of chronic oxygen and temperature conditions during rearing than by acute conditions during testing. Furthermore, our study shows that individual variation in growth performance can be traced back to individual differences in rates of food and oxygen consumption. Developmental acclimation also gave rise to differences in CTmax, but these were relatively small and were only expressed when CTmax

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