Distinct impacts of food restriction and warming on life history traits affect population fitness in vertebrate ectotherms

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Abstract

Body size shifts in ectotherms are mostly attributed to the Temperature Size Rule stating that warming speeds up initial growth rate but leads to smaller size when food availability does not limit growth. Nevertheless, climate warming can decrease food availability, which can influence growth, fecundity and survival. However, the interactive effects of temperature and food availability on life history traits have been mostly studied in small invertebrate species. In contrast, we have limited information on how temperature and food availability jointly influence life history traits in vertebrate predators and how changes in different life history traits combines to influence population demography. We investigated the independent and interactive effects of temperature and food availability on traits of the medaka fish Oryzias latipes. We used our empirical estimates of vital rates as input parameters of an Integral Projection model to predict how modifications in vital rates translate into population demography. Our results confirm that warming leads to a higher initial growth rate and lower size leading to crossed growth curves between the two temperatures. Food-restricted fish were smaller than ad libitum fed fish throughout the experiment. Fish reared at 30 °C matured younger, had smaller size at maturity, had a higher fecundity but had a shorter life span than fish reared at 20 °C. Food restriction increased survival under both temperature conditions. Warming reduces generation time and increases mean fitness in comparison to the cold treatments. Food restriction increased generation time and fitness in the cold treatment but had no effect in the warm treatment. Our results highlight the importance of accounting for the interaction between temperature and food availability to understand how body size shifts can affects vital rates and population demography. This is of importance in the context of global warming as resources are predicted to change with increasing temperatures.

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