Resource allocation trade-offs and senescence may explain the temperature-size rule in aquatic organisms

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Abstract

Decrease in body-size with increasing temperature is a common (but not exclusive) pattern in ecology. Regarding ectotherms, temperature generally benefits initial growth but has a negative impact on size at maturity. Since life-history theories generally predict a larger size at maturity in environment that speed up initial growth, this pattern (referred as to the temperature-size rule, TSR) looks like an evolutionary paradox. Constrains on cell size, asymptotic size or aerobic scope have been proposed to explain this life history puzzle. However, none of them fully explained its generality or the baseline processes. Surprisingly, resource allocation trade-offs or senescence have rarely been considered.

In aquatic ectotherms, the metabolism and the risk of anoxia increase with temperature, ultimately enhancing oxidative stress. It is well known that reactive oxygen species (ROS) lead to ageing and senescence. Interestingly, the disposable soma theory (DST) states that there is a trade-off in the allocation of resources to self-maintenance and other activities (e.g. growth), and especially reproduction. Thus, the DST offers an interesting framework to study the TSR.

Here, we compared the oxidative balance and life history traits of *Ozyrias latipes* individuals reared at two non-stressful temperatures (20∘C vs 30∘C) over three generations. According to the DST, we observed more damages and less defenses in somatic tissues than in germline cells at 30∘C. These results were concomitant with TSR patterns. Interestingly, the reproductive success was similar between the two groups because of a higher reproductive effort but a lower adult and offspring survival rates at 30∘C.

Keywords: body, size, senescence, oxidative stress, warming, fish, life, history, trade, offs

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