Editorial Board members (3)

* Stenseth, Nils C
* Hastings, Alan

NAS members who are expert in the paper’s scientific area (3)

* Same as editorial board members

Reviewers (5):

* **Felisa Smith**
* Dustin Marshall
* Jennifer Sheridan
* Craig White
* **Jennifer Sunday**
* Daniel van Denderen
* Gretta Pecl
* Curtis Horne
* **Joel Kingsolver**
* Sjannie Lefevre
* **Philipp Neubauer**
* Raymond Huey
* Michelle Tseng
* David Atkinson
* **Diego Barneche**

Dear Editor,

I am submitting the manuscript ‘*Optimum growth temperature declines with body size within fish species*’ for consideration to be published as a research report in *PNAS*.

Understanding how key physiological processes such as growth, feeding and metabolism depend on body size and temperature is key for predicting impacts of global warming on individuals, populations and food webs. In growth models and mechanistic population models we often rely on interspecific estimates to characterize these relationships (1, 2). This is problematic, since growth, feeding and metabolism are individual-level processes, and thus likely are accurately represented by intraspecific relationships. However, intraspecific estimates are surprisingly rare in the literature, in particular average intraspecific estimates *across* species, which are needed for making general predictions.

In this study we aim to overcome this by first collating intraspecific experimental data on fishes using a standardized literature search (total n=3672 from 59 studies). Next we apply hierarchical Bayesian models to estimate average mass and temperature dependence of these rates within species by accounting for variation across species. Lastly, we investigate the implications of our estimated scaling relationships for fish growth using a common supply and demand growth model.

Our results show that, on average, metabolic rates increase faster with body mass than feeding rates within species, and that feeding rates are unimodally related to temperature. This leads to the prediction that the optimum temperature for growth declines with body mass within species. By collating an independent data set on growth of fishes using the same protocol, we corroborate that optimum growth temperatures decline with fish body size, in line with the prediction based on the scaling of feeding and metabolic rates.

Therefore, we believe our study provides fundamental insights to how physiological rates and body growth are affected by warming that should be of interest to a broad readership. We also clearly identify deviations from general metabolic scaling theories at the within-species level. Overall, our study highlights the need to investigate intraspecific relationships as these deviate from interspecific patterns, and suggests a simple mechanism to explain the common pattern that large individuals within ectothermic species are the first to experience reduced growth with increasing temperatures.

We are grateful for your consideration of our manuscript, and we look forward to hearing from you.

Sincerely,

Max Lindmark, on behalf of all co-authors

Swedish University of Agricultural Sciences, Department of Aquatic Resources (SLU Aqua),

Institute of Coastal Research, Skolgatan 6, 742 42 Öregrund, Sweden, Phone: +46(0)104 78

41 73, mobile: +46(0)722 10 72 66, [max.lindmark@slu.se](mailto:max.lindmark@slu.se)

1. D. J. Marshall, C. R. White, Have We Outgrown the Existing Models of Growth? Trends in Ecology & Evolution 34, 102–111 (2019).

2. D. A. Vasseur, K. S. McCann, A mechanistic approach for modelling temperature-dependent consumer-resource dynamics. The American Naturalist 166, 184–198 (2005).