Effects of food availability and growth variation on ontogenetic metabolic scaling in zebrafish

Alexander Rosén* and Tommy Norin.

Introduction

- Metabolic rate (MR) has been thought to have a fixed increase with body mass (BM), with a scaling exponent (b in MR = aBM^b) of 0.75[1].
- But, more and more research is finding variation in metabolic scaling[2].
- Scaling can be divided into evolutionary. (between species), static (between individuals) and ontogenetic (in an individual as it grows).
- A previous study had found that fast-growing individuals have steeper ontogenetic metabolic scaling in one species but not another[3].
- These differences might be due to different feeding regimes.

Research questions

Does food availability and growth rate affect ontogenetic metabolic scaling in zebrafish?

METHODS

- Fish kept individually.
- Fed 1, 2 or 3 times a day.
- Metabolic rate measured with intermittent-flow respirometry.
- Each fish measured 8 times during ontogeny.

Fish in respirometry chambers

Fish in individual tanks

RESULTS

- No significant effect was found between ontogenetic scaling of standard metabolic rate (SMR) and either growth rate or feeding regime (low, moderate, high).
- Significantly steeper slope for static scaling compared to ontogenetic scaling (b = 1.04± 0.02 *vs.* 0.99 ± 0.02).

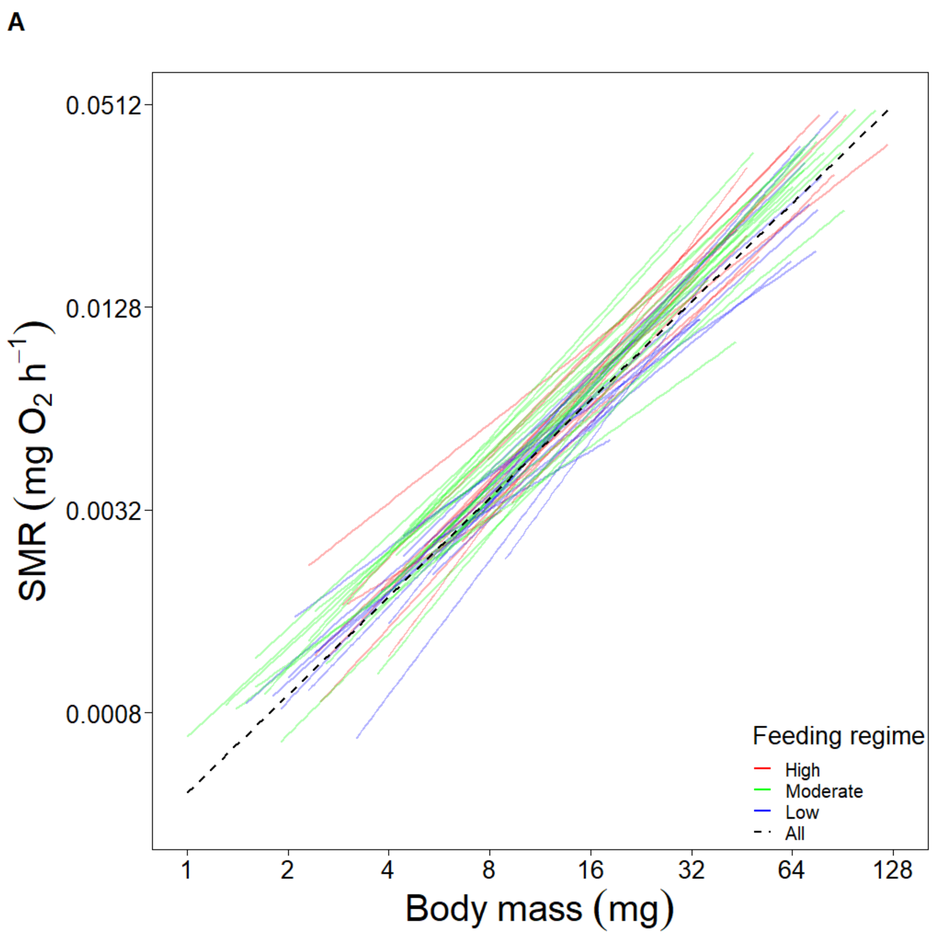

Figure A: Standard metabolic rate (SMR) as a function of body mass, on logarithmic axes, with each solid line representing an individual fish as it grows. Color-coded for feeding treatment with, red for high, green for moderate and blue for low. The black striped line represent the overall trend.

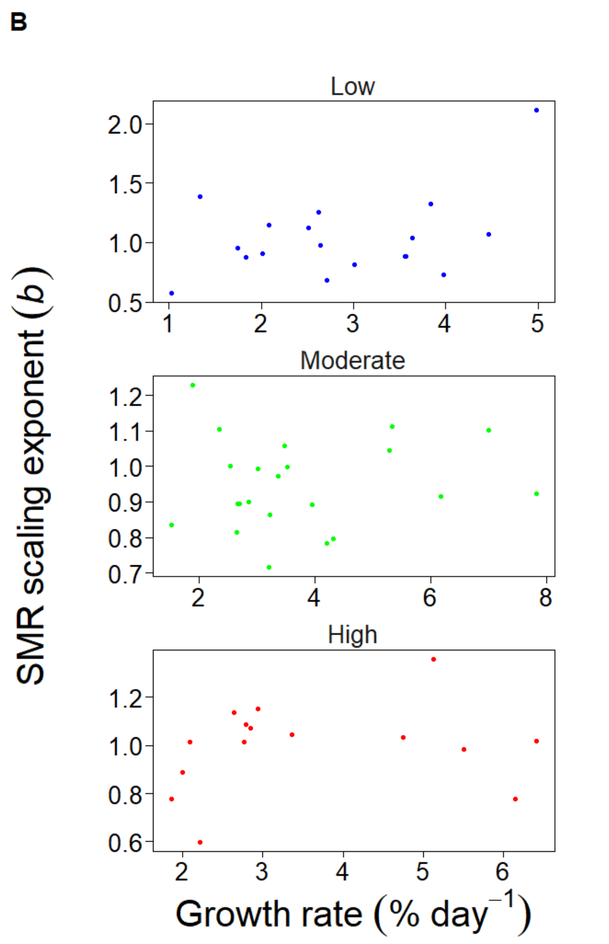

Figure B: The individual standard metabolic rate (SMR) scaling exponents as a function of growth rate for each individual fish for each of the three treatments.

DISCUSSION

- The previously-observed correlation between growth rate and ontogenetic metabolic scaling may be species specific and not necessarily related to feeding rate.
- Higher static than ontogenetic scaling might be linked to (early-life) mortality, under the hypothesis that static scaling reflects the mean ontogenetic scaling of surviving individuals in a population, although other factors might also play a part.
- Continued investigations into variation in the overlooked ontogenetic metabolic scaling is important as it represent the taxonomic level on which evolution happens.

***Presenting author**
Alexander Rosén
PhD-student
Section for Marine Living Resources
DTU Aqua |Technical University of Denmark

Technical University of Denmark

VILLUM FONDEN

DANMARKS FRIE FORSKNINGSFOND

[1] Kleiber M (1947) Body size and metabolic rate. *Physiol. Rev.* 27, 511-541.
[2] Glazier DS (2005) Beyond the '3/4-power law': variation in the intra- and interspecific scaling of metabolic rate in animals. *Biol. Rev.* 80, 611-662.
[3] Norin T (2022) Growth and mortality as causes of variation in metabolic scaling among taxa and taxonomic levels. *Integr. Comp. Biol.* 62, 1448-1459.