**Proposal for a Contribution to the special issue on “Ecological and Evolutionary Insights from Very Long-Term Studies” to be published by Ecology Letters in 2024**

Proposed contribution type: Letter

Corresponding author name: Max Lindmark/Jan Ohlberger

Corresponding author email: max.lindmark@slu.se

Preliminary list of coauthors: Max Lindmark1, Jan Ohlberger2, Anna Gårdmark1

Institutional affiliations of all coauthors: 1Swedish University of Agricultural Sciences, Department of Aquatic Resources, Sweden, 2 School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195, USA; 3 Washington Department of Fish and Wildlife, 1111 Washington St. SE, Olympia, WA 98501, USA

Proposed title: Non-linear response of growth to temperature across latitude leads to opposite response to warming for cold and warm populations

**Proposal (expected length < 300 words) which should (a) briefly describe the long-term dataset(s) that you are analyzing, including study site location, observations, experimental treatments if relevant, and the years involved, (b) succinctly explain why the proposed manuscript would be novel, important, and of general interest in ecology and (c) explicitly state the importance of very long-term data for this study.**

**a)** We compiled a novel dataset of length-at-age of Eurasian perch (*Perca fluviatilis*) from annuli rings on operculum bones (215,975 measurements across 41,212 individuals) from 12 monitoring areas along the Baltic Sea coast (56.1°–65.9° latitude). The longest time series starts in 1953 and the average time series length is 32 years. Temperature data were compiled from 3 sources with complementary strengths: ERSST data (long time series, low spatial-temporal resolution), temperatures during fishing (long time series, low temporal resolution, co-sampled with the fish), and daily temperatures from data loggers (short time series, high temporal resolution, proximity to samples). Two of the monitoring areas have been artificially warmed by nearby nuclear power plants, resulting in whole-lake warming ‘experiments’, and large temperature contrasts in our data (both within and across areas), with average summer temperatures of 7°C-23°C.

**b)** General rules have been proposed for the relationship between growth and temperature in ectotherms, but robust tests in natural populations are scarce, possibly due to a lack of long time series with temperature contrasts. Here we fit growth models and analyze them in relation to local temperatures. Because of the time series and large thermal gradient, we can identify an overall non-linear relationship of growth along a temperature gradient, and that cold populations show a positive response to warming whereas warm populations show a negative response to warming. This is an important contribution to our understanding of climate change effects on organisms’ growth and size in the wild, which are key for predictions in both applied and fundamental ecology.

**c)** To test general predictions about climate change impacts on body growth of ectotherms, it is crucial to acquire long term data sets on individuals’ traits, with large temperature contrast and spatial replicates, because only such data make it possible to robustly identify climate signals given natural variation and fluctuations.

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