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**Larger but younger fish when growth compensates for higher mortality in warmed ecosystem**

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Abstract

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The effects of increasing water temperature on key life history traits of fish (e.g. growth rate and maximum body size) have in recent years received considerable attention, but evidence remains inconclusive. Warmer water will increase the metabolic rate, which in turn can increase body growth, if this higher energy demand can be met by increased food intake. Increased metabolic rate is also predicted to increase mortality rates of fish, even though the literature on this is less conclusive. When it comes to effects of temperature on maximum body size, opinions vary. Studies have found or predicted negative effects of temperature on maximum body size while a recent study on a non-commercially exploited fish showed no clear signs of smaller adult body size. These diverging observations warrant more studies quantifying fish responses to warming. Both temperature and fishing are expected to induce changes in growth rate and maximum body size, and the interactions between, and relative importance of, these factors are difficult to quantify in commercially fished populations. Therefore, it is important to quantify general patterns of temperature responses on non-commercial species in natural environments. Fish growth and mortality are of high ecological importance since they determine the size and age structure within a population, which affects resilience capacity of a fish stock. Here, I ask how growth rate, asymptotic size and mortality may change in response to increased temperature, and what the implications for populations size-spectra and mean size will be. To this end, I collate and analyse fish life history data (1987-2003) of perch (Perca fluviatilis) from a unique large-scale natural heating experiment, and a reference area with normal temperatures. I found that perch exposed to higher water temperature had higher growth rates and greater length-at-age compared to the reference population. Moreover, mortality rates were higher in the population exposed to higher water temperatures. Despite the higher mortality rates, my results suggest that the perch population exposed to higher water temperatures had larger mean length and a less steep slope of its size spectrum, indicating a higher proportional abundance of large individuals compared to the reference population. These results suggest that the positive effects of temperature on growth rates can compensate for the higher mortality in the populations exposed to warmer water on the overall size-structure.

Introduction

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Results

Results

Discussion

Discussion

Materials and Methods

*Data*

Data

*Statistical Analysis*

Statistical Analysis

Code and Data Availability

All data and R code (lists of studies in literature search, data preparation, analyses and figures) can be downloaded from a GitHub repository (<https://github.com/maxlindmark/warm_life_history> ) and will be archived on Zenodo upon publication.

References

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Author Contributions

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Additional Information

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