

Higher mortality rates leave heated
ecosystem with similar size-
structure despite larger, younger,
and faster growing fish

Max Lindmark, Swedish University of Agricultural Sciences,
Department of Aquatic Resources

maxlindmark.netlify.com | [@max_lindmark](https://twitter.com/@max_lindmark) 

ICES ASC DUBLIN 2022

Background

- Effects of warming on size and growth of fishes often depends on body size & life stage
- Most evidence from experimental studies or commercially exploited species
- We generally lack data from large-scale natural experiments & unexploited species

Data

Study system

- Biotest basin: enclosed lagoon on the Baltic coast
- Heated with nuclear cooling water to become +8°C above normal temp
- Scientific sampling only source of mortality



Photo: Göran Hansson

Study system



Data

- Eurasian perch
- > 22 000 back-calculated length-at-age (operculum bones and otoliths)
- > 8 000 individuals
- 1980-2003



Linda Nyman/ArtDatabanken



photo: <https://www.slu.se/institutioner/akvatiska-resurser/miljoanalys/individniva1/Aldersanalys-av-fisk/>

Methods

Approach

Size-at-age

- von Bertalanffy model
- Shared or area-specific parameters?

Catch curves

- Log abundance \sim age
- Support for different slopes, $-Z$?

Growth rate

- Length-based allometric growth model
- Support for area-specific parameters?

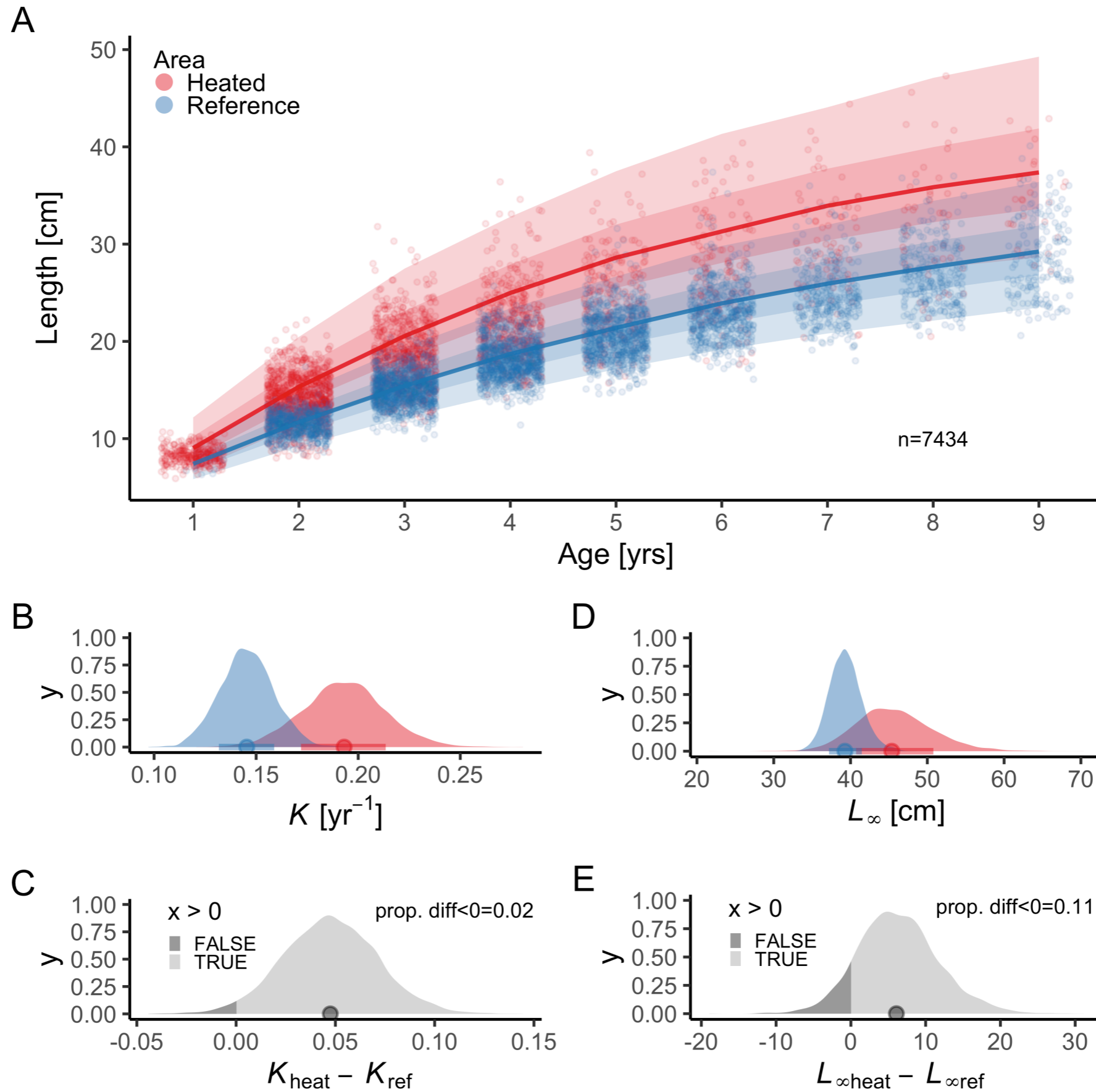
Size spectrum exponent

- MLE bin method*
- Difference in size-spectrum slope?

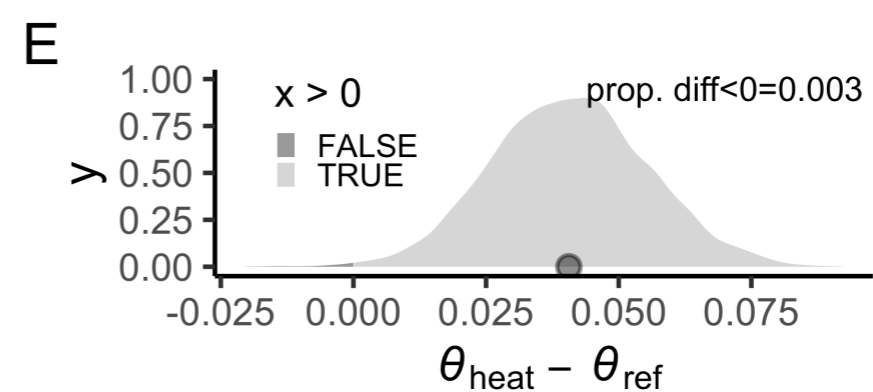
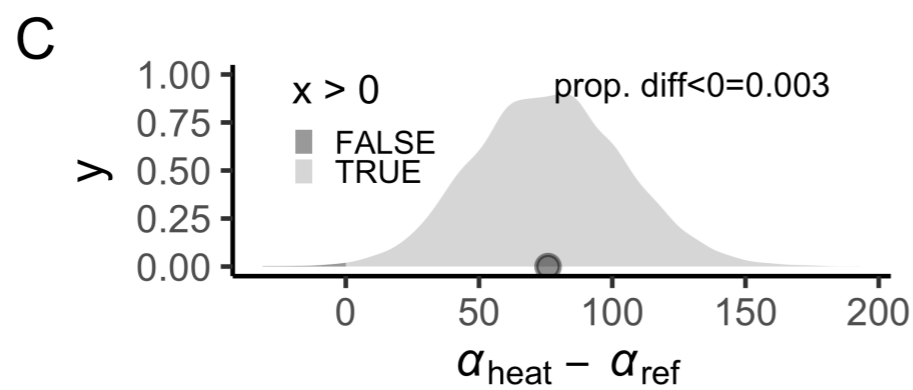
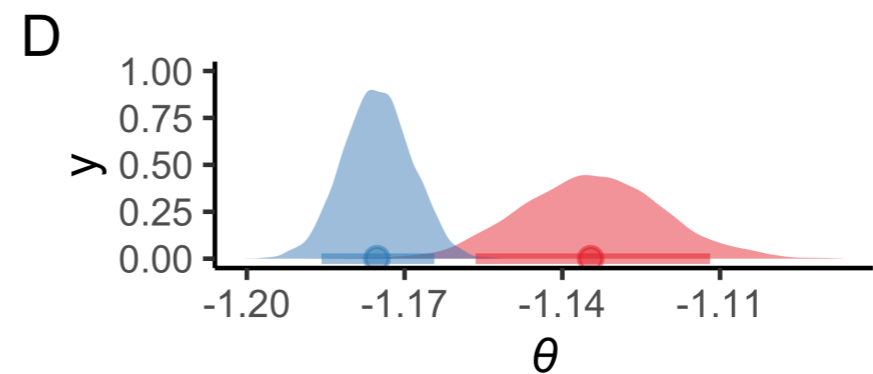
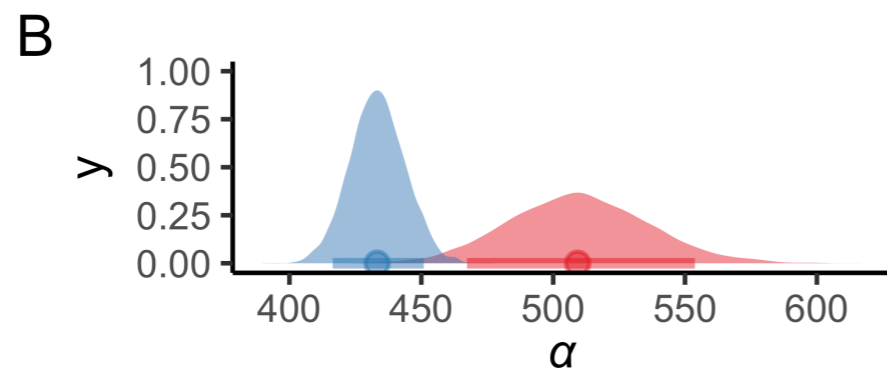
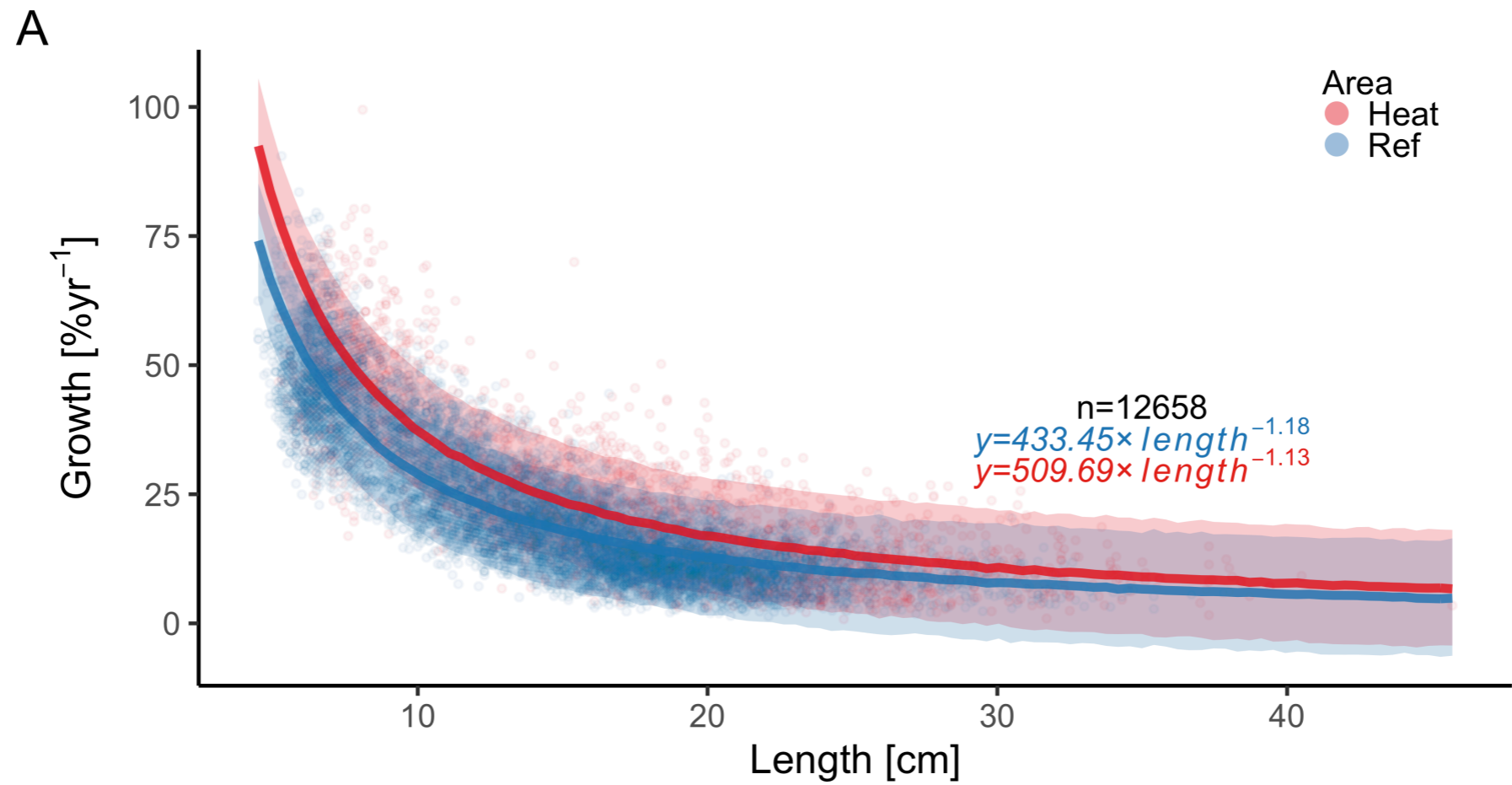
*Edwards et al. (2017, 2020); brms (Bürkner, 2022)

Results

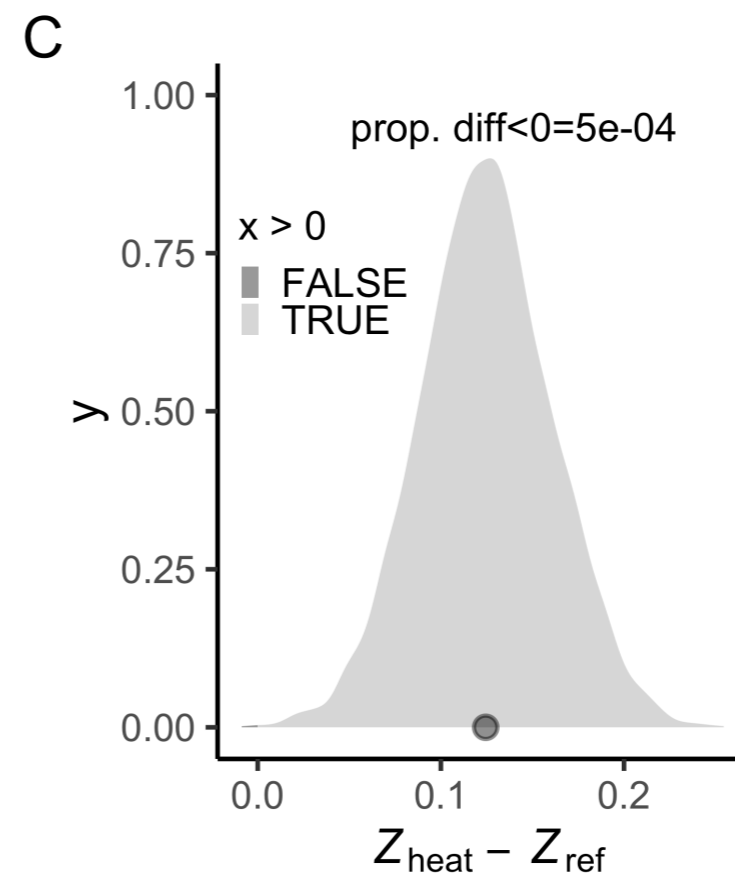
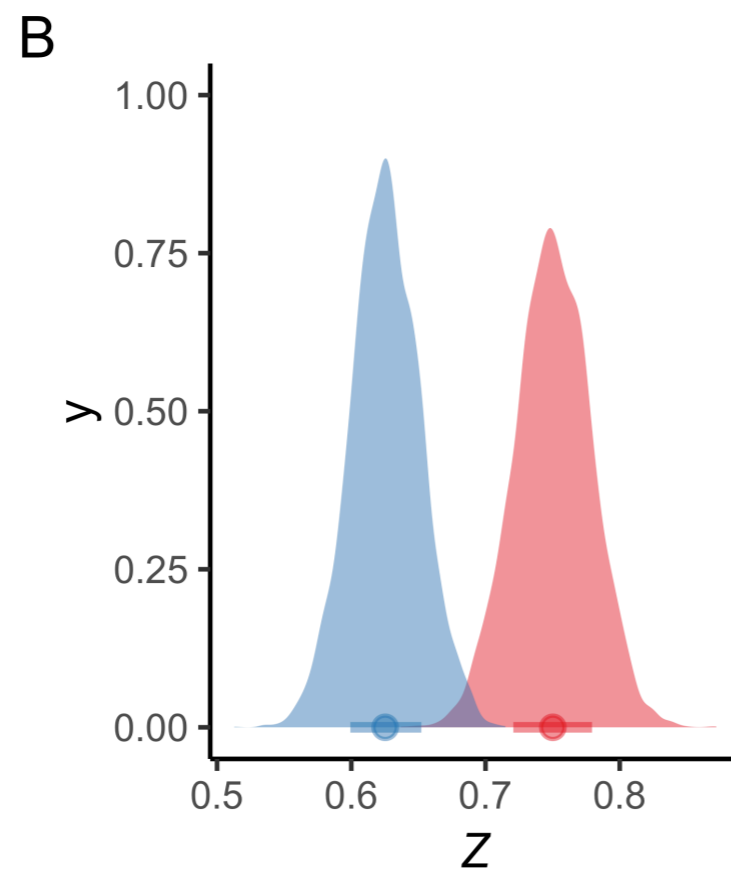
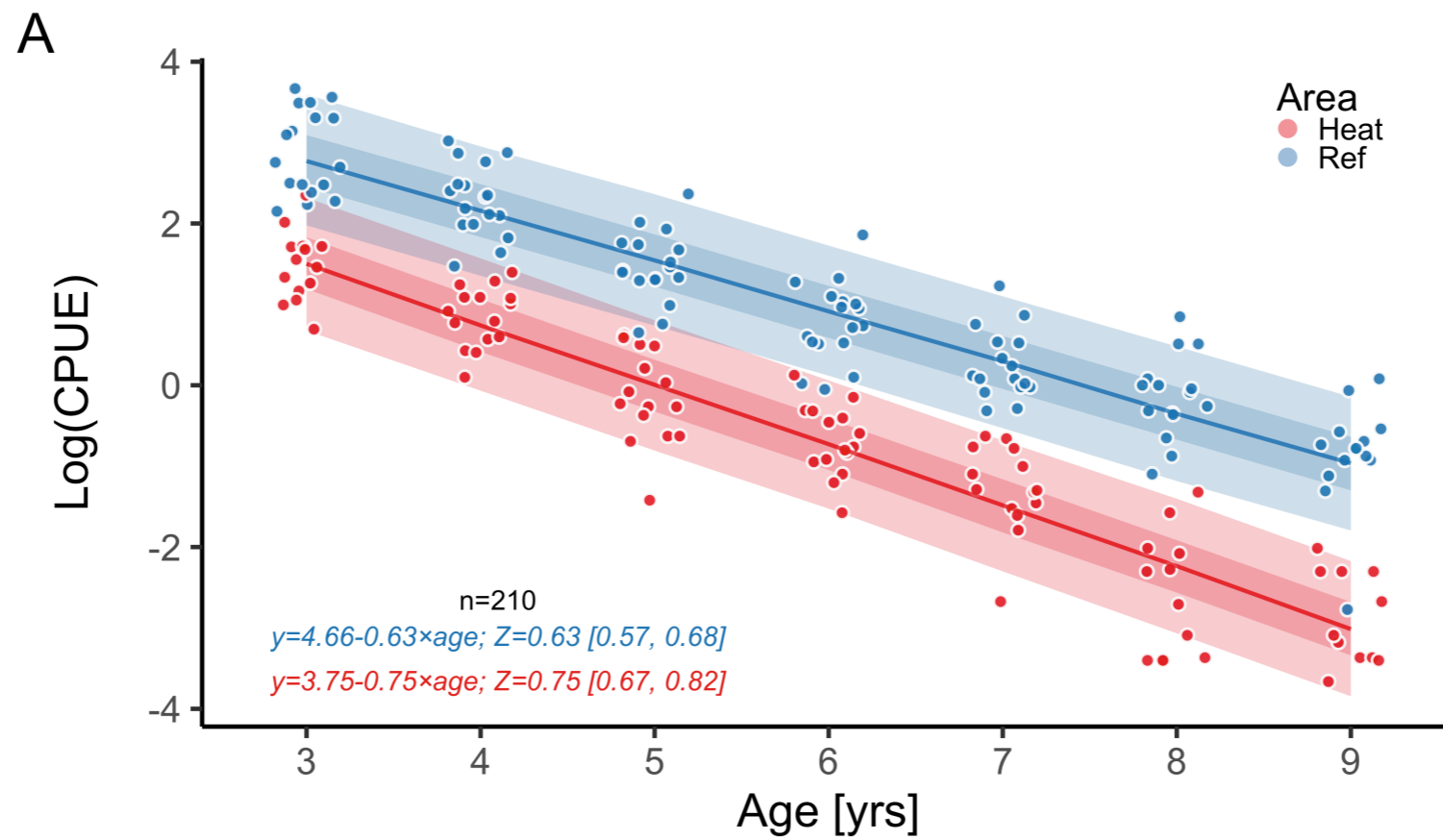
Larger size-at-age throughout ontogeny in the warm area



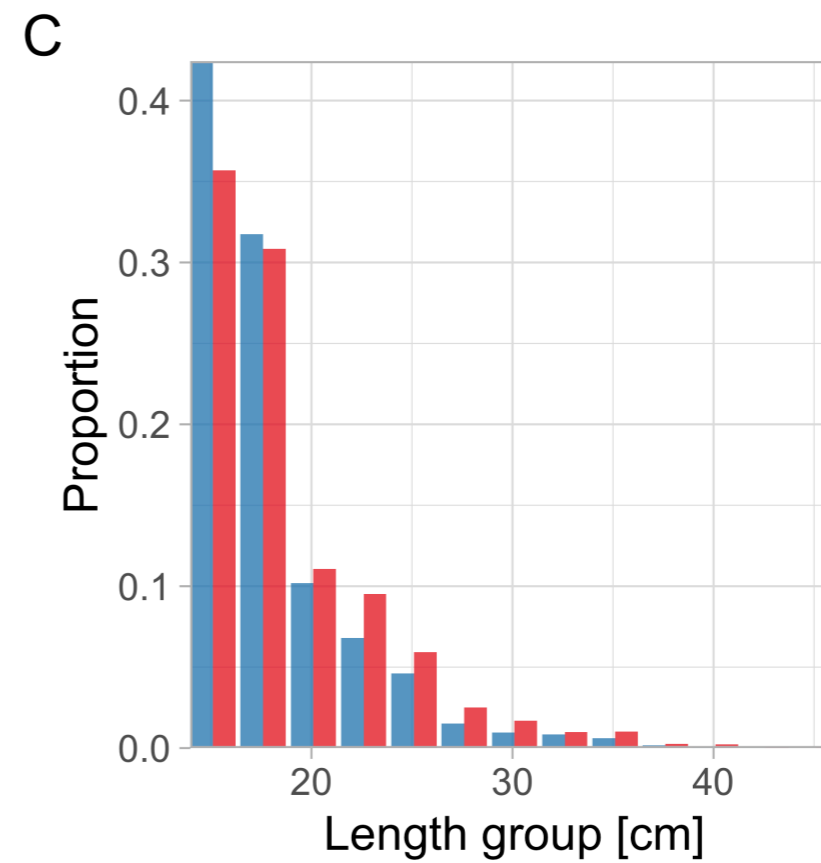
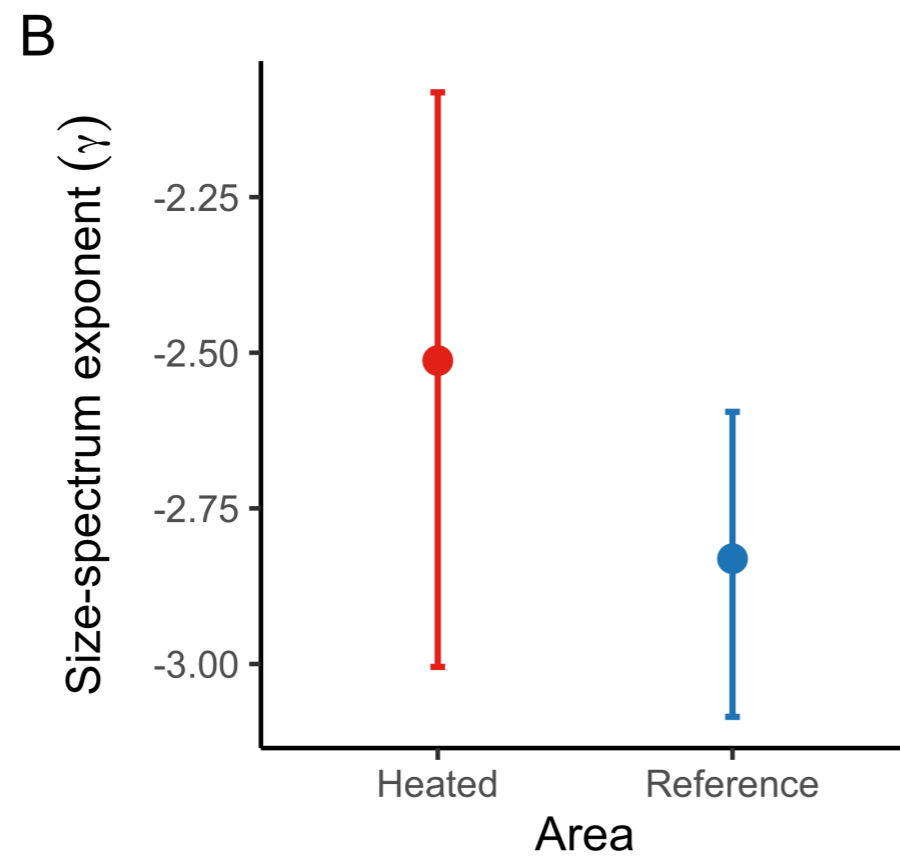
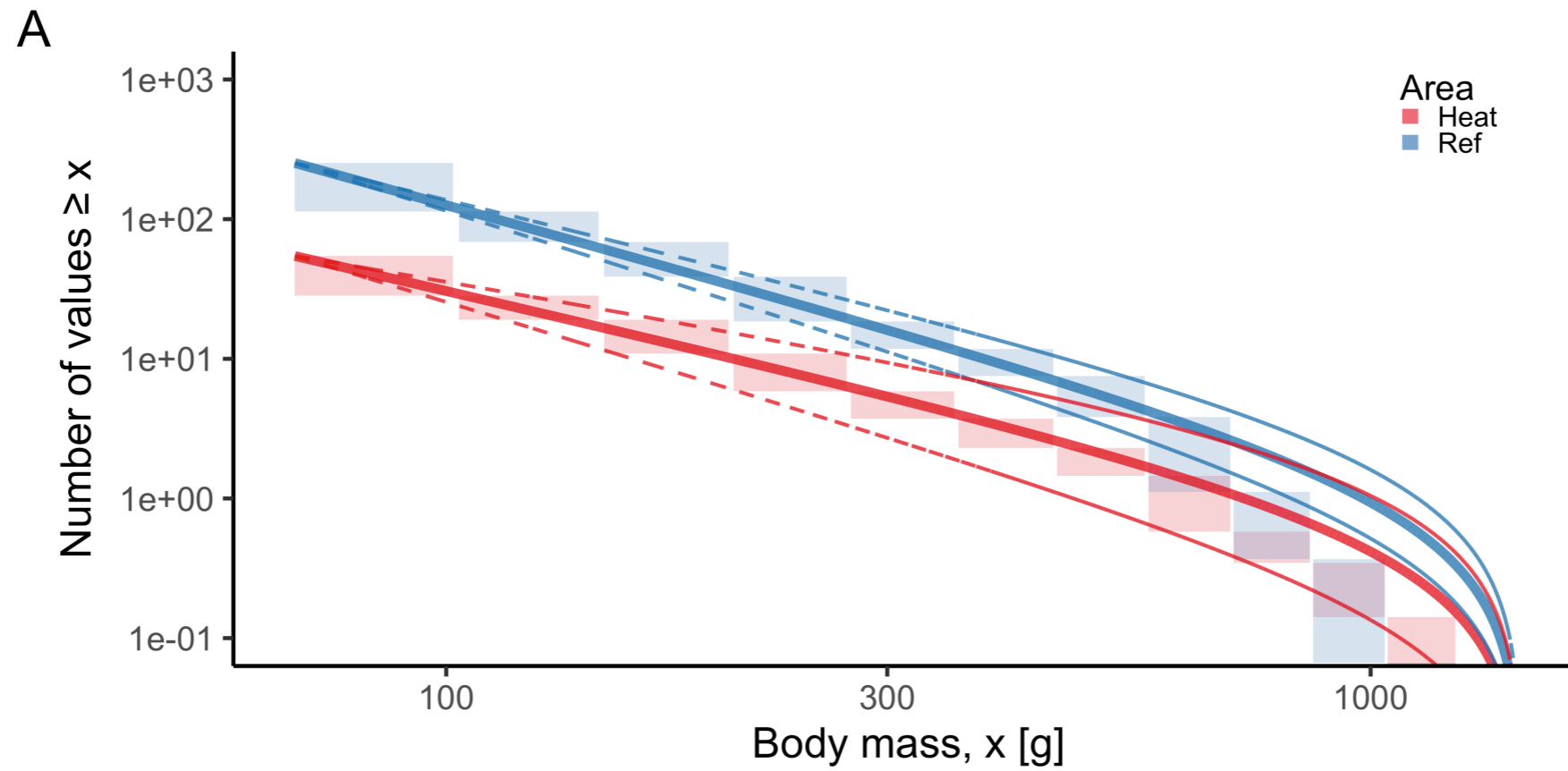
Growth rates faster for all sizes in the warm area



Higher mortality rates in the warm area



Largest fish in warm area but similar size spectrum exponents



Summary

Summary

- Increased growth rates & size-at-age offset higher mortalities to the degree that size structure is similar
- Growth & size results not consistent with the temperature-size rule
- Must consider changes in mortality when linking changes in growth to changes in size-structure

Thank you for listening!

Max Lindmark, Swedish University of Agricultural Sciences,
Department of Aquatic Resources

maxlindmark.netlify.com | [@max_lindmark](https://twitter.com/@max_lindmark) 

ICES ASC DUBLIN 2022