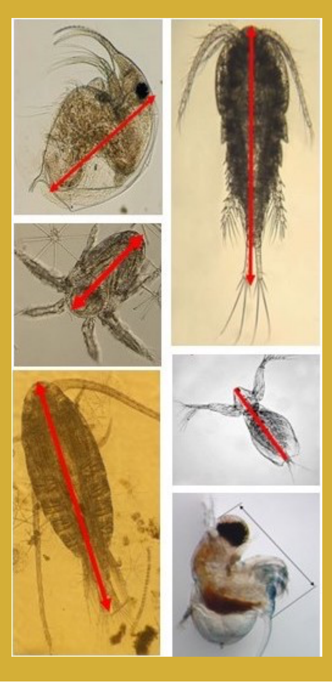

# Worldwide body size distributions of freshwater crustacean communities - are global mechanisms overriding local ones?

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## Framework of the study

**Body size** is a key functional trait that affects many physiological and ecological processes. Among ectotherms, body size patterns are strongly influenced by temperature variation (temperature-size rule). Consequently, climate change is likely to alter body size patterns affecting ecosystem function, particularly in size-structured aquatic communities. However, predicting the impacts of climate change on aquatic communities is challenging due to the multiple interacting factors involved (e.g., exploitation, nutrient enrichment). Hence, there is a need to collect detailed global data on body size of keystone organisms (i.e., zooplankton) and environmental characteristics of their habitats.

The **thermal regions scheme**, introduced by Maberly et al. (2020, *Nat. Comm.*) to classify the thermal behavior of lakes according to their annual surface temperature, provides an opportunity to investigate the size structuring of zooplankton along gradients in temperature and climate.

The **ZooSize** project was launched in 2021 to create a global database of **individual crustacean zooplankton body size measurements** along with environmental factors from an array of freshwater lakes to address the following questions:

1. How do **zooplankton community size metrics** (e.g., size diversity, mean size, and metrics describing size distributions) change across lake thermal regions?
2. How do other **local environmental factors** affect the body size-temperature relationship within and across thermal regions?

## Methodology

We launched a data call for community composition and individual body size measurements. We required data for only one sampling date per lake, at the time of peak seasonal biomass. We also asked for some characteristics of the lake (coordinates, altitude, depth etc.) and limnological variables (temperature, chlorophyll-a concentration, etc.). Track the main project updates on the page: https://rosalieb.github.io/rosaliebruelweb/ZooSize.html.

We received data for 315 lakes over 4 continents. Data harmonization shows that about 25% of the data do not fit our initial requirements (60+ individual measurements and full community data), so the overall final number of lakes will be lower. The availability of potential explanatory variables varies among datasets and may constitute another filter for inclusion of the sites in subsequent analysis (Fig. 1). For this poster, we used the method presented in Quintana et al. (2008, *Limnol. Oceanogr.*) to calculate community size diversity and geometric mean size for crustaceans across thermal regions (Fig. 2).

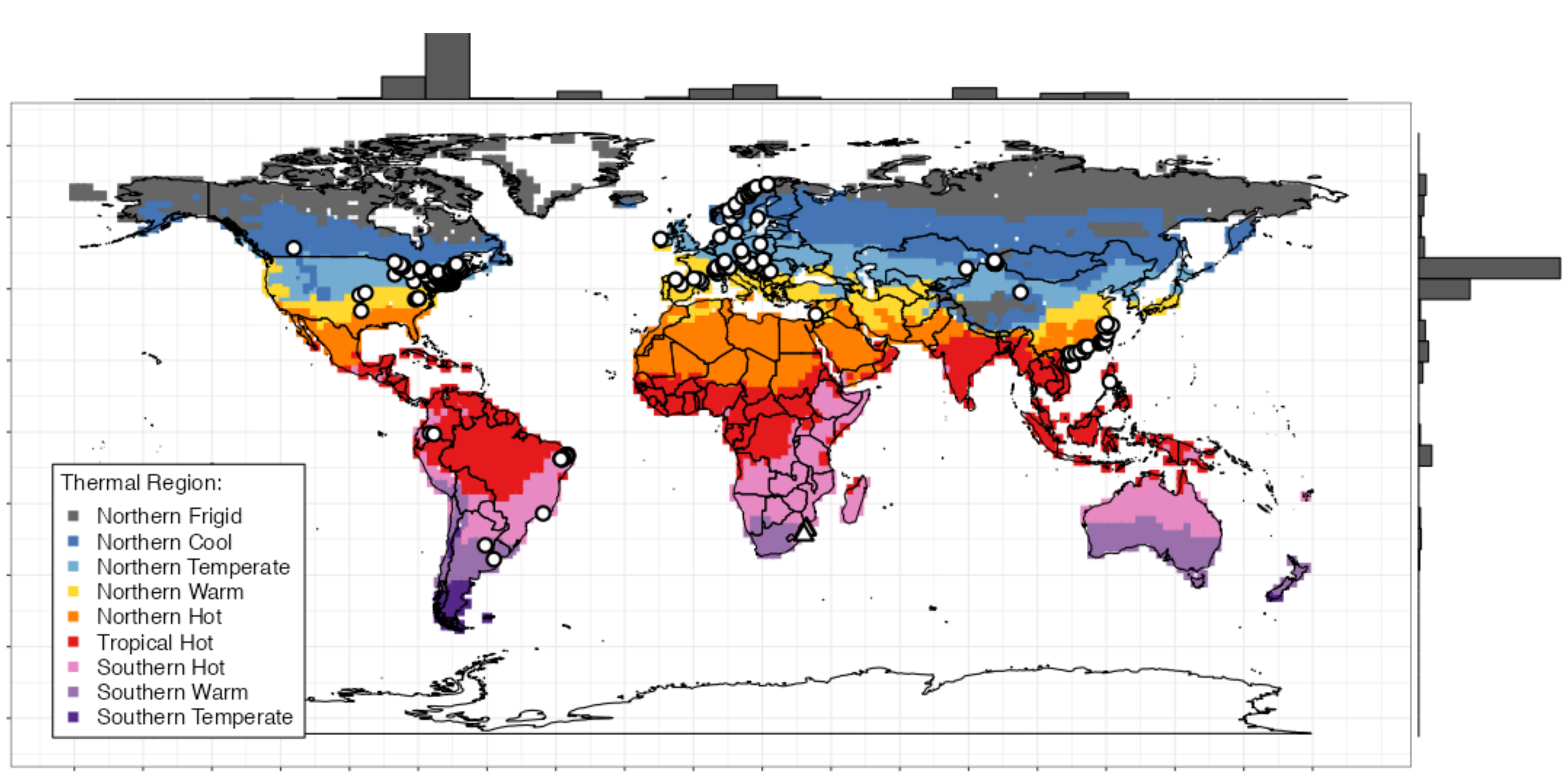


*Figure 1.* Global map of submitted (points) and expected (triangles) data across lake thermal regions. Histograms on the top and right margins indicate the number of lakes per longitude and latitude, respectively. Map modified from Maberly et al. (2020)

## Acknowledgements

This work benefits from participation in or use of the Global Lake Ecological Observatory Network. *Important disclaimer:* This version of the poster was sent for printing before validation by the whole co-authors list. To see the final poster (version July 2023), scan the QR code below.

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## Preliminary Results

**Note:** Those are preliminary results and data harmonization and qualification is not complete.

Metrics were calculated for communities with 60-1215 individual measurements. Mean community size ranged 0.13-1.49 mm, and size diversity indices ranged 0.53-3.00.

The preliminary results show differences in size distribution across thermal regions, and notably, smaller individuals at latitudes characterized with warmer climate, which is consistent with existing hypotheses (Daufresne et al, 2009, *PNAS*). These communities are also showing higher values of size diversity (Fig. 2).

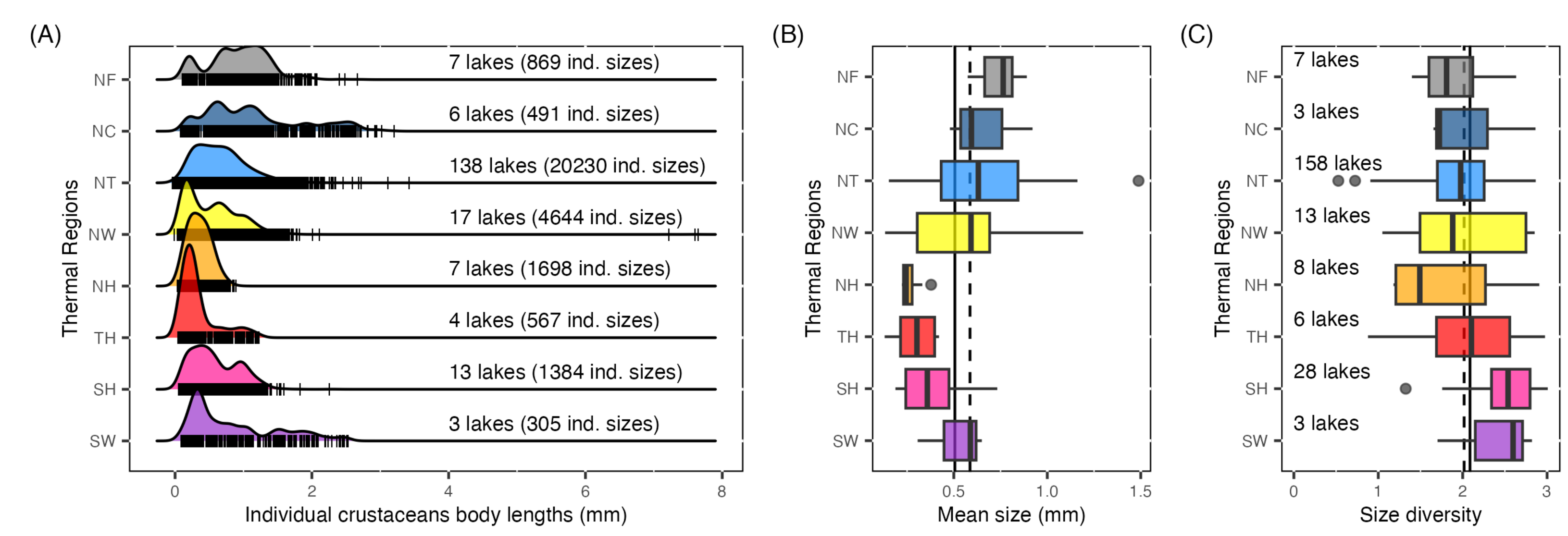


*Figure 2.* (A) Size distributions, (B) community geometric mean size, and (C) size diversity for crustacean zooplankton per thermal region (colors - see Fig. 1 for key). In (A), Number of lakes and number of individual size measurements are shown per thermal region. Dashed and full vertical lines in (B-C) are averages across the dataset and thermal regions respectively. Discrepancies in number of lakes between (A) and (C) come from some different levels of QC progress; the final result will look slightly different.

## Perspectives

Size is an interesting indicator to compare ecosystem functioning across broad scales, because it does not rely on taxonomy and its potential inherent weaknesses (hybridisation, differences in operator, etc.).

If thermal regions alone are good predictors of zooplankton size structure, it may indicate that ecosystem functioning might shift with future climate change trends, not least because up to two-thirds of lakes may dissociate from their current thermal regions under the most pessimistic climate scenario at RCP8.5.

Future work will tackle the issues of differences in number of lakes per thermal region (leads: resampling, explicit models accounting for different sample sizes). Furthermore, we will take into account the contribution of other variables, such as Chl-a, a proxy for primary production (Fig. 3).

Our unique and comprehensive dataset will provide critical insights into the impacts of climate change on global patterns of zooplankton community size structure and how body size can be used as an indicator of ecological status in lake conservation and restoration.

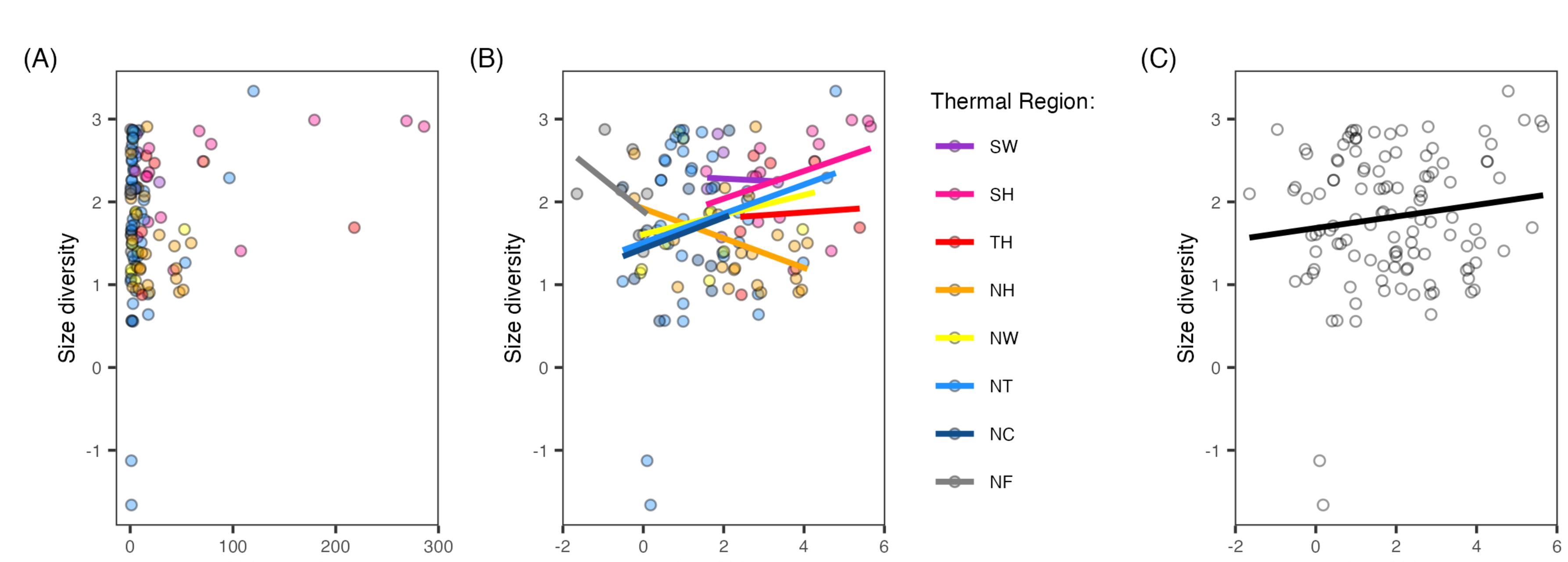


*Figure 3.* (A) Size diversity against chlorophyll-a values (Chl-a in ug/L), (B) Relation (line stat_smooth, method = "lm") between logarithm of chlorophyll-a (as a proxy for bottom-up forcing) and thermal regions (colors) to explain the differences in size diversity, (C) Relation (line stat_smooth, method = "lm") between logarithm of chlorophyll-a, without differentiating by thermal regions, to explain the differences in size diversity.

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