

Hacking Limnology 2024

4th joint Virtual Summit and Workshops

15-17th July AEMON-J Workshop

18-19th July DSOS Summit



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Insights from global data collection on freshwater zooplankton body size

ZooSize



project's page



From left to right, top to bottom: Lake Taal (PH) © Marjohm Baludo, Lake Ponjavica (RS), © Zorka Dulić, La Era (ES) © Mercedes López-Vázquez, Lake del Colastiné (AR), © Maria Florencia Gutierrez, Lake Anterne (FR) © Rosalie Bruel, Lucieński Lake (PL) © Dariusz Halabowski, Lake Most (CZ), © Maria Anton

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All 80 authors are involved in meetings and conceptualisation

aA

Taxa names harmonization



Preservative survey



Map verifications



Current leads of the project

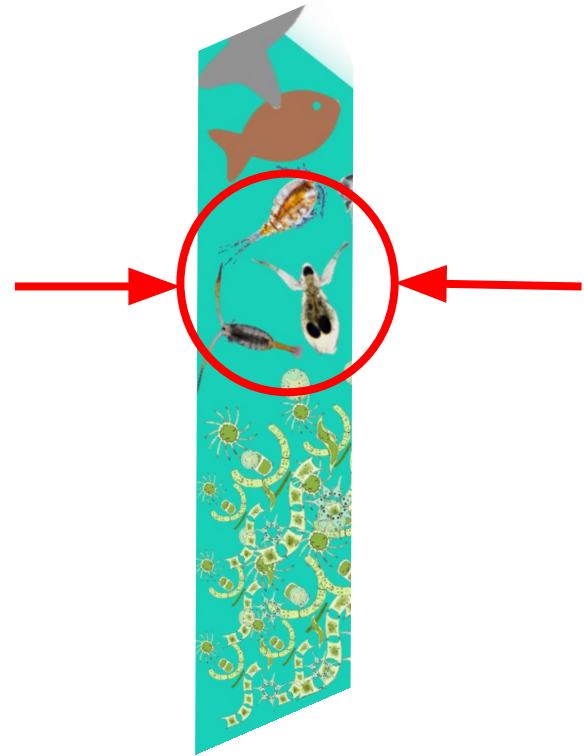


Zooplankton Workshop

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Why is **zooplankton** a potential good indicator of ecological state?

- Short generation times
- Intermediate position in food web
- Responsive to bottom-up and top-down stressors
- Abundance and body size easily measured



Why **size**?

Size is an **easily measured trait (measurement can be automated)**.

Pros:

- integrative ecological concept,
- avoid taxonomic errors,
- effective way to link community structure to ecosystem functioning.

Reducing organisms to their size is an often **controversial viewpoint**, but there is knowledge to be gained by **reconciling size-based and taxonomy-based approaches** (Petchey and Belgrano, 2010).



Question:

How do size distributions of crustacean zooplankton communities differ across the globe and how are they influenced by bottom-up and top-down processes?

Framework of the study

↓ **Temperature**
(Bergmann's rule)
(e.g., Beaver et al. 2020;
Gillooly and Dodson, 2000)

↓ **Predation**
(e.g., Vanni, 1986, 1987)

↓ ↑ **Resources**
(e.g., Karpowicz et al., 2020)

Individual body size

↪
What about
community size
distribution?

↪ Energy transfer

↪ Trophic interactions

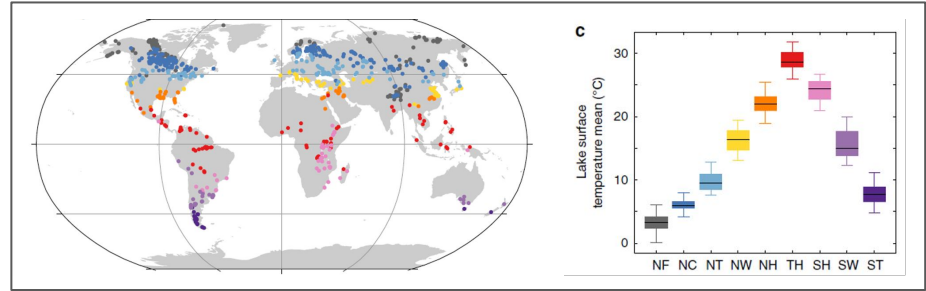
↪ Resource utilization

↪
How do these
factor interact in
driving size?

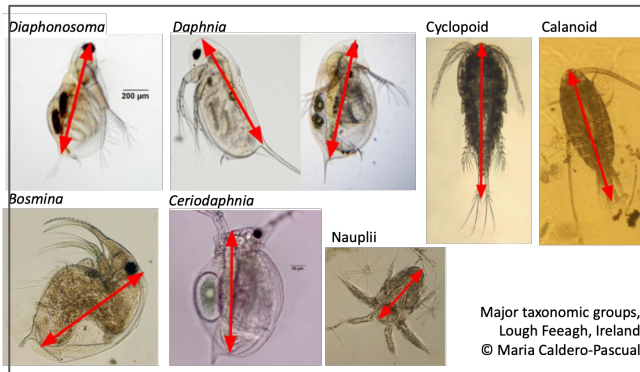
Hypothesis: temperature * resources * predation INTERACTIONS!

Previous studies...

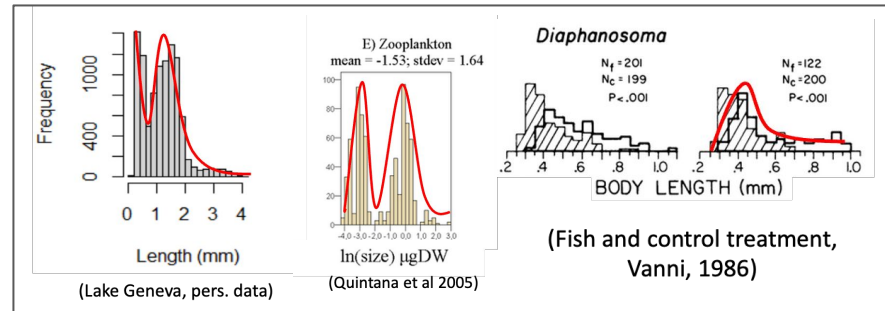
(1) either focussed on regions in the world or did not include other factors affecting size: **our objective was to have as close as a global coverage as possible** (thermal regions, Maberly et al 2020) + **include multiple drivers**



(2) (often) focussed on Cladocera and/or strictly Daphnia: **we wanted to investigate size variation the whole crustacean zooplankton community**



(3) focussed on mean size (but see Quintana et al. (2008) for example): **we wanted to test for multiple size metrics**



⇒ A new data call was required.

We asked for only ONE sampling event but extensive metadata to disentangle temperature, nutrients and (hopefully) predation effects.



Data template*

- 1. Contact information
- 2. **Metadata:** lake size, latitude, longitude, multi-bassins or not, sampling net and other method, etc.
- 3. **Limnodata:** dominant piscivore and planktivore, physico-chemical variables
- 4. **Zoo counts:** crustacean zooplankton ID and densities
- 5. **Zoo size:** individual size measurements for every taxa in tab 4.
- 6. *Additional information (willing to collaborate to future project, etc.)*

CATEGORY	VARIABLE	UNITS	NOTES	ANSWER	COMMENTS
General	lake_full_name	text	Full name of body of water and common denomination (what we would use in a paper to refer to the body of water, e.g., "Lake Champlain, Lough Feeagh, Crater Lake"	Lough Feeagh	
General	lake	text	Name of body of water (do not include "Lake" or "Reservoir". For example, use "Champlain" and not "Lake Champlain"	Feeagh	
General	type	text	"Lake" or "Reservoir"	Lake	
General	lat	decimal degrees	Latitude of waterbody; could be center of waterbody or your sampling station or what you decide	53.95	
General	long	decimal degrees	Longitude of waterbody; could be center of waterbody or your sampling station or what you decide	-9.58	
General	tz	text	Time zone (as UTC offset)	UTC +1	
General	alt	metres	Elevation of waterbody above sea level	20	
General	lake_area	Square kilometres	Surface area of the waterbody	3.95	
General	watershed_area	Square kilometres	Surface area of the watershed	100	
General	depth_max	metres	Maximum depth of the waterbody	45	
General	depth_mean	metres	Average depth of the waterbody	14.5	
General	multi_basin	text	MULTI-BASIN lake: "Yes" or "No"	No	
General	precipitation_regime	text	If the lake is not in a temperate location, what was the general precipitation regime like? "wet" or "dry" or "NA"	NA	
General	thermal_region	text	NE, NC, NT, NW, NH, TH, SH, SW, ST	NT	

* MultiLakes data template available
* ZIG to ZooSize script available



Data harmonisation

ZIG to ZooSize code

ZIG Dataset
transferred by email for data providers who agreed

Compiled to ZooSize
Dataset INPUT

ZooSize Dataset ORIGINAL COPY

ZooSize Dataset INPUT

ZooSize MultiLake Dataset ORIGINAL COPY

ZooSize MultiLake INPUT

Run Common function

5 datasets (1 per original tab) saved as a list
mainZooSizefiles_asobjects_Rdata

Final dataset

EXTRA INFORMATION
preservative survey;
measurement correction factor;

QC
taxa names

Visual screening and manually correct general errors (email data provider if specific questions)

Manually update INPUT dataset (if needed)

Run Detail issues
Flagging data based on:
1. General range
2. Depth specific range
3. Mismatch taxa
4. Not enough measurements
5. Missing data

All issues resolved

Harmonisation task

- Automated
- Semi-automated
- Manual



Track changes

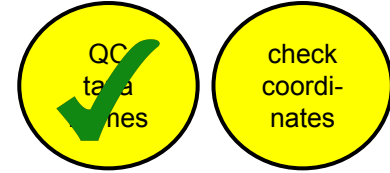


Specific emails to data providers

Perspectives on our data harmonisation approach

Pros:

- Easy to include a new dataset (one unique script)
- When entry data do not have any errors, it is easy to merge them to the general dataset (2% of the datasets had no flag at all, only 1% dataset had >5 issues)
- The script allowed us to compartmentalize the issues and solve them one by one



Cons:

- although most errors are small and easily fixed, we still have to include a manual step of back and forth with data providers to double check errors
- we reached a wall with that step that requires a lot of concentration to keep track of emails.

⇒ Future solution could be to implement automatic verifications in the data template (e.g., secchi depth cannot be greater than lake maximum depth, flag TP/TN values if greater than expected range, etc.).

Manual taxa names harmonization may be required no matter what.

The step helped reduce mismatches between the tab “Zoo counts” and “Zoo size”.

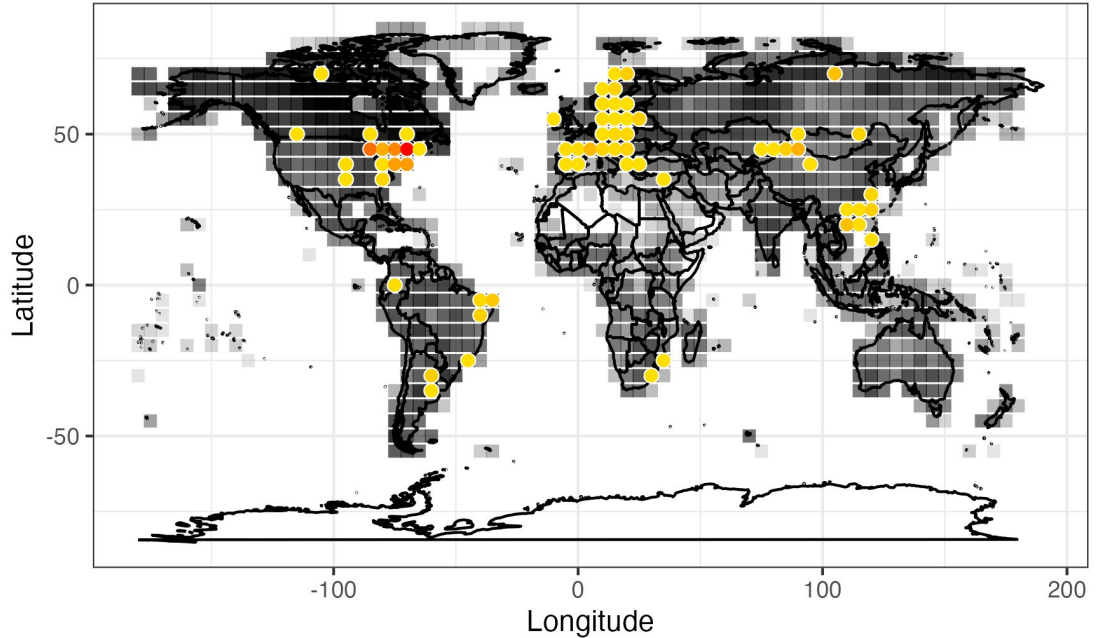
The ZooSize dataset

360
lakes

51 data
providers

3833 observations

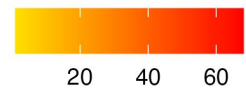
median = 1 observation per lake
max = 706 observations for one lake



Number of lakes ≥ 10 ha in the HydroLakes database (Messenger et al, 2016)

0 20 140 180 22020

Number of lakes in the ZooSize dataset



Preliminary analysis:

- mean size vary greatly across thermal region
- mean size and size diversity give two different information about community structure

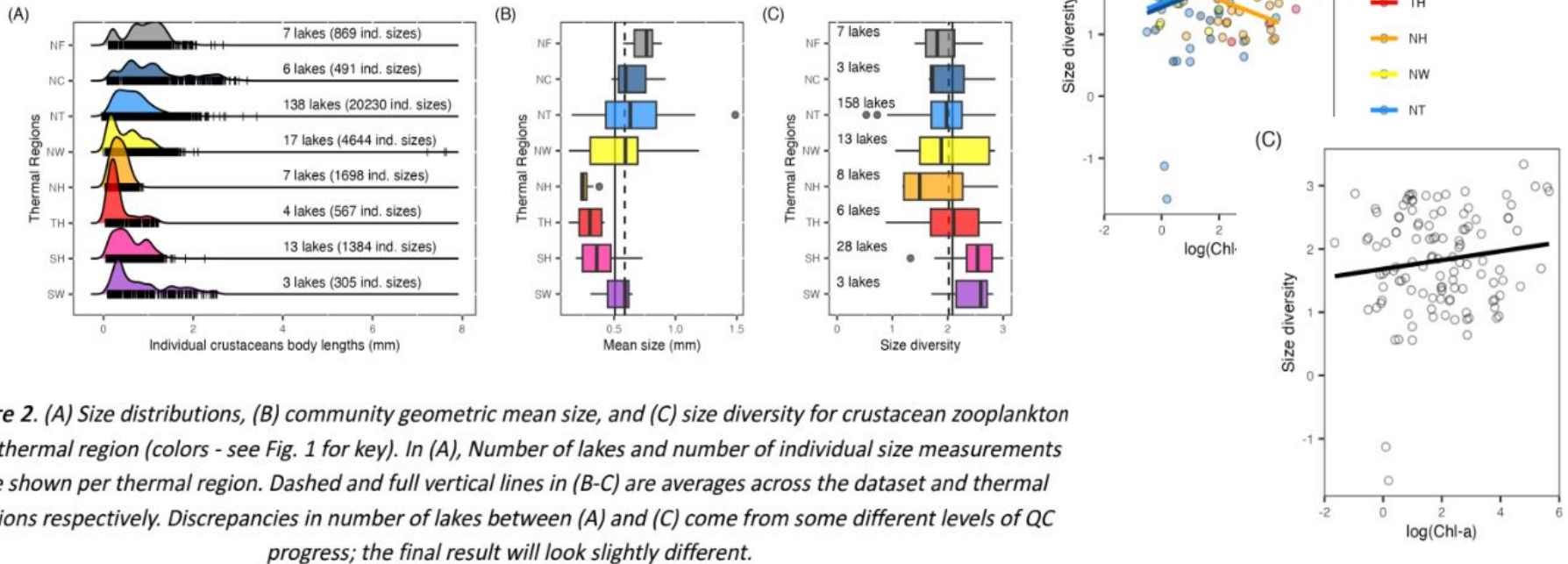


Figure 2. (A) Size distributions, (B) community geometric mean size, and (C) size diversity for crustacean zooplankton per thermal region (colors - see Fig. 1 for key). In (A), Number of lakes and number of individual size measurements are shown per thermal region. Dashed and full vertical lines in (B-C) 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.

Insights from global data collection effort

- Biggest difficulty: not having ZooSize clearly identified as a project for either of us (~90% of the time spent on ZooSize was “voluntary” work) ⇒ we are hoping to find a way to finance a few months of postdoc to help
- Use of project management tools (Google Drive, github, ...) really helps!
- Using a common script worked for us to assemble the main dataset and allowed us to start the analyses early on.
- We used these preliminary analyses in posters and presentation
 - it may have baited new contributors :)
 - it motivated us to keep moving forward!

Next steps

- Publish the dataset as a data paper
- Test our hypotheses and write a paper using the dataset
- Perspective paper on collecting and assembling the data (joint paper with ZIG?)



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project's page

Thank you, Merci, Gracias, Obrigado/Obrigada, Danke, Grazie, Děkuji, Kiitos, Tack, Dankie, Ngiyabonga, 谢谢, Tak, Ευχαριστώ, Köszönöm, Go raibh maith agat, תודה, Paldies, Takk, Kia ora, Salamats, Dziękuję, Хвала!



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