

Dataset of benthic copepods in the littoral zones of Lake Maggiore

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ABSTRACT

Copepods (Crustacea: Copepoda) are widespread in aquatic ecosystems worldwide and represent an important component of the meiobenthic metazoan assemblages of lake littorals. Yet, little is currently known about the diversity of benthic copepods in lentic habitats. We gathered information on the benthic copepod assemblages of the littoral zone of Lake Maggiore as part of the Interreg Italy-Switzerland 2014-2020 Parchi Verbano Ticino project (ID: 481668), funded by the European Regional Development Fund (ERDF). Lake Maggiore is a large and deep temperate lake in north-western Italy human-managed from mid-March to mid-September. This contributes to substantial changes in water levels in relation to human activities such as hydropower, industrial and agricultural uses. We compiled a dataset listing 234 occurrences of benthic copepod species recorded from three littoral sampling sites situated in three protected areas, two of which are part of the Natura 2000 network in Italy and one is part of the Emerald Network in Switzerland. We collected the specimens during the summer-autumn period in 2019-2021. We identified the copepods to the species level and created a dataset with individual georeferenced occurrence records for each species, organized in a standardized Darwin Core Archive format. We made available, through the Global Biodiversity Information Facility (GBIF), a total of 13 distinct taxonomic entities and 234 unique georeferenced occurrence records related to the benthic copepod assemblages of the littoral zone of Lake Maggiore. The dataset has the potential to support the authorities in charge of managing Lake Maggiore's water levels in addressing the ecological risk relevant to the littoral zone and in developing shared implementation strategies for sustainable water management.

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INTRODUCTION

Copepods (Crustacea: Copepoda) are widespread in freshwater and marine environments worldwide (Boxshall and Defaye, 2008), and they play a significant role in meiobenthic trophic webs (Schmid-Araya and Schmid, 2000). In lakes, benthic copepods are distinctive for their key ecological roles as deposit-feeders (mainly harpacticoids; Sarvala, 1998), selective grazers of microbial biofilm and diatoms (both harpacticoids and cyclopoids; Rollwagen-Bollens *et al.*, 2013; Leitão *et al.*, 2018), and predators (mainly cyclopoids; Sarvala, 1998; Muschiol *et al.*, 2008). Benthic copepod species inhabiting lake littorals may serve as an excellent model taxon for investigating the ecological risk of human-induced water level fluctuations (Cifoni *et al.*, 2022). For example, benthic harpacticoids are less abundant during low water levels when they show avoidance reactions to increasing wave action (Foy and Thistle, 1991). In contrast, generalist copepod species, such as omnivores, deposit-feeders and opportunists, are abundant during low water levels because they can withstand disturbance and even thrive in it (Cifoni *et al.*, 2022). Yet, there is still little knowledge readily available about the ecology of lake meiobenthic metazoans, particularly of copepods (Cifoni *et al.*, 2021), especially when it comes to lentic water bodies under human-induced water level fluctuation.

tuations. According to Vadeboncoeur *et al.* (2011), 14 out of the 253 largest lakes in the world are home to around 9% of the world's biodiversity of non-insect freshwater invertebrates. Due to the overall paucity of databases tackling the distribution of lake meiobenthic metazoans, this biodiversity share is likely underestimated (Cifoni *et al.*, 2021). The diversity patterns of benthic copepods of lake littorals remain insufficiently described (Sarvala, 1986). This knowledge gap is critical because the lake edge is a crucial habitat for many organisms and is often highly modified for human uses (Schmieder, 2004). To fill this knowledge gap, we were involved in the 2019-2023 Interreg Italy-Switzerland Cooperation Program "Parchi Verbano Ticino" project (hereafter referred to as PVT), which aimed to address the increasing stakeholders' demand for water from Lake Maggiore (Italy - Switzerland). Lake Maggiore is a large, temperate subalpine lake belonging to the National, European and international Long-Term Ecological Research networks (LTER: <https://elter-ri.eu/>). The lake's water level is managed from mid-March to mid-September to meet the needs of stakeholders for water use. Specifically, Lake Maggiore is regulated by the Miorina Dam to maintain the lake levels in a specific range to satisfy agriculture and industry needs and to control floods and drought events (Boggero *et al.*, 2022). Usually, the lake levels are highest in late spring and gradually decrease until reaching a minimum value in the early autumn due to water use by stakeholders, low summer precipitations, and scarce snow inputs. The regulation of the lake levels and water use by stakeholders can affect the water quality and availability of resources, which could impact the biodiversity of the lake. In the PVT project, macro- and meiobenthic assemblages of the lake littoral in relation to the effects of lake water regulation were analyzed (Boggero *et al.*, 2022). The project's primary outcome will be a common implementation strategy for shared and sustainable management of Lake Maggiore waters and for the protection of littoral and surrounding riparian areas, with a special focus on protected natural areas.

Within the framework of the PVT project, a georeferenced dataset of meiobenthic copepod assemblages was developed. This paper describes the dataset and makes it freely accessible online for future uses. The dataset could be useful to develop more effective strategies for protecting and managing the lake's biodiversity. For example, the dataset could help identify areas of the lake that are particularly important for benthic copepod diversity and abundance, which could be helpful in making decisions about where to focus conservation efforts. It could also provide information about which copepod species are more vulnerable to human-induced water level fluctuations, which could help prioritize conservation actions for these species. In addition, the dataset could be used to monitor changes in benthic copepod communities over time, which could

help assess the effectiveness of conservation efforts and identify areas where additional actions may be needed. The first dataset of littoral benthic copepod occurrences in Lake Maggiore will contribute to any future study on European freshwater benthic copepod diversity and distribution.

Summary statistics

Following the Darwin Core standard (Wieczorek *et al.*, 2012), a dataset with georeferenced distribution sites of benthic copepod species in three sandy beaches of Lake Maggiore (area = 213 km²; altitude = 193 m a.s.l.; max depth = 370 m; trophic status = oligomesotrophic; precipitation = 1700 mm yr⁻¹ vs the national average of about 900 mm yr⁻¹) was created. The dataset was compiled at CNR-IRET with the collaboration of CNR-IRSA. It includes occurrence records and abundance data of species of Copepoda Harpacticoida and Copepoda Cyclopoida of the littoral zone of Lake Maggiore that were collected from three sampling sites (Fig. 1): Bolle di Magadino (MA), which is situated in the homonymous Smeraldo protected area in Switzerland, Fondo Toce (FT) and Sesto Calende (SC), in two Natura 2000 network sites in Italy. Two types of habitats at each site were examined: one that was permanently wet (W) and the other that underwent drought (D) during low lake levels. In each habitat, three spatial replicates were collected along an oblique transect from a fixed point of lakeshore (Fig. 1). Samples were collected on six occasions during summer months, between 2019 and 2021, and during periods of low (193.41 m in September 2019 and 193.06 m in August 2020),

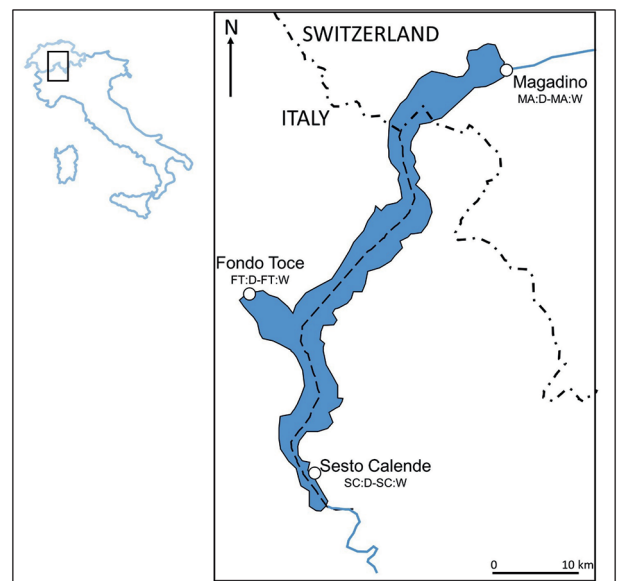


Fig. 1. Sampling sites (white points) distributed along the coasts of Lake Maggiore. D, dry habitat; W, wet habitat.

medium (193.41 m in August 2019 and 193.75 m in September 2020) and high water level (194.03 m in July 2020 and 194.22 m in 2021). Therefore, the dataset is composed of six geo-referenced sites (MA:W, MA:D, FT:W, FT:D, SC:W, SC:D), with three spatial replicates each (Tab. 1). The dataset includes 234 occurrence records belonging to 13 copepod species (Fig. 2), 9 genera, 3 families and 2 orders. Of the 234 records, 66% belong to the order Cyclopoida Cyclopidae and 34% to Harpacticoida (28% to Camphocamptidae, 6% to Ameiridae). *Paracyclops fimbriatus* (Fischer, 1853) is the most abundant cyclopoid species (32%), while *Attheyella crassa* (Sars G.O., 1863) prevails (22%) among harpacticoid species. The water level period with the lowest number of records (68) was the medium one, while the high and low water level periods had 83 records each. The lowest species abundances were recorded during the low water level periods, while the highest were recorded during the high water level (Fig. 2). Our survey's sampling effort effectively captured the diversity of benthic copepod assemblages in Lake Maggiore, resulting in the discovery of four previously undocumented species.

DISCUSSION

Temporal trends in the dataset highlight the importance of monitoring Lake Maggiore at different water levels to better understand the biodiversity occurring in the lake and its littoral zone. The effect of water level fluctuations on the copepod species in the lake is evident. Species abundances were highest during high water levels and lowest during low water levels, likely because the littoral zone is less hospitable during low water levels (Cifoni *et al.*, 2021). Epigeal copepods prefer hyperbenthic environments with higher oxygen and nutrient levels and are dispersed through processes involving the overlying water column (Dole-Olivier *et al.*, 2000). In environments with active hydrodynamics such as the lake littoral zones, breaking waves cause sediment to be reshuffled and scoured, leading to the suspension of meiofauna. Copepods are particularly susceptible to this phenomenon, with harpacticoid copepods

dispersing 65 times faster than nematodes (Commito and Tita, 2002; Giere, 2009). In comparison to other georeferenced databases (*e.g.*, the CKmap, the publicly available database that includes information on the distribution of over 1200 plant and animal species across Italy; Stoch, 2001), the dataset of this study focuses exclusively on the distribution of benthic copepods in just three sandy beaches of Lake Maggiore. However, it provides detailed information on the temporal dynamics of copepod populations in relation to lake level fluctuations and water uses not considered in other databases. On the other hand, the CKmap also includes information on the species conservation status, which our dataset does not encompass. The dataset from this study can provide useful information for the managers of Lake Maggiore's water levels. By analyzing the data, they can have a clearer and more complete idea of how the benthic copepod community in the littoral zone responds to changes in water levels. This information can support them in developing strategies for managing the lake's water levels in a way that minimizes the ecological risk in the littoral zone and promotes sustainable water management practices.

Dataset description

The dataset includes 22 columns, with each row containing a record of a harpacticoid or cyclopoid species with taxonomy information in accordance with the Darwin Core Standard. All records are georeferenced occurrence data that have been uploaded to the Global Biodiversity Information Facility (GBIF) with the following permanent link: <https://www.gbif.org/dataset/78e81992-16c2-4644-9820-4b0dbe19f2a2>. The 22 columns show the event ID number, the occurrence ID, the basis of record, the event date, the scientific name of the species, the taxon rank. There are 9 columns that refer to kingdom, phylum, subphylum, class, order, family, subfamily, genus, species. Further columns show geographic coordinates, unit of measure and reference system, country code, locality, organism count referred to a standardized sample of 150 meiofaunal individuals (see Sampling design paragraph), and organism quantity type (Tab. 2).

Tab. 1. Geographic coordinates (WGS 84 decimal degrees) of the sampling sites in Lake Maggiore and abbreviation used in the data set.

SS-H	ID	R	CC	LC	Latitude N	Longitude E
Bolle di Magadino - D	MA:D	R1, R2, R3	CH	LM	46.150444444444	8.85707222222222
Bolle di Magadino - W	MA:W	R1, R2, R3	CH	LM	46.1601305555556	8.85447777777778
Fondo Toce - D	FT:D	R1, R2, R3	IT	LM	45.9362861111111	8.49082222222222
Fondo Toce - W	FT:W	R1, R2, R3	IT	LM	45.9353000000000	8.49296944444444
Sesto Calende - D	SC:D	R1, R2, R3	IT	LM	45.7536222222222	8.59136388888889
Sesto Calende - W	SC:W	R1, R2, R3	IT	LM	45.7516194444444	8.59318611111111

SS-H, sampling site-habitat (D, dry; W, wet); ID, sampling site acronyms (MA, Bolle di Magadino; FT, Fondo Toce; SC, Sesto Calende); R, replicate numbers; CC, country code (CH, Switzerland; IT, Italy); LC, lake code (LM, Lago Maggiore).

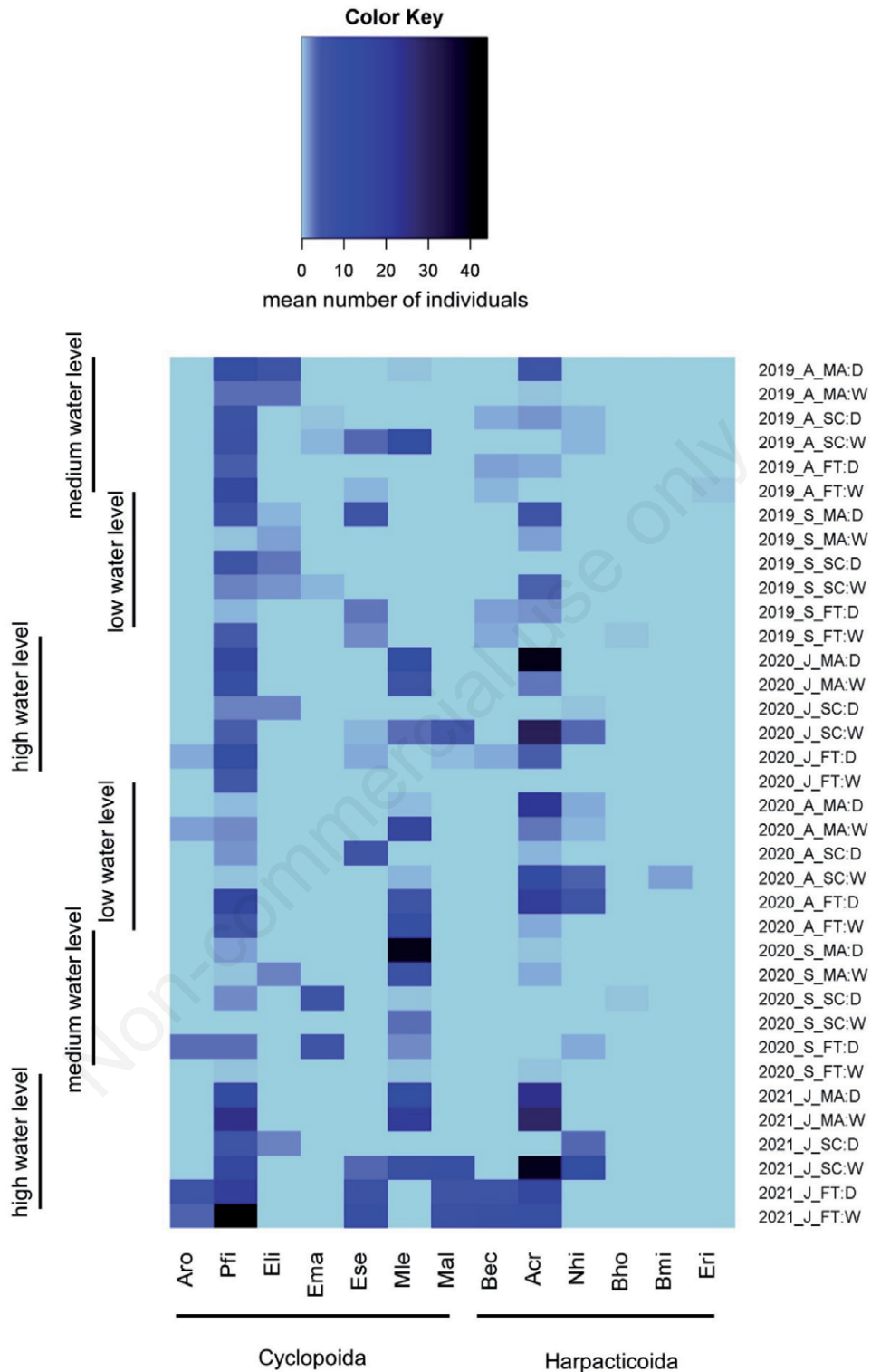


Fig. 2. Mean abundances (number of copepods individuals of the three spatial replicates) of benthic harpacticoids and cyclopoids collected from three littoral sampling sites at Lake Maggiore. Species and sample abbreviations are as follows: J, July; A, August; S, September; MA, Bolle di Magadino; FT, Fondo Toce; SC, Sesto Calende; D, dry, W, wet; Aro, *Acanthocyclops robustus* (Sars G.O., 1863); Pfi, *Paracyclops fimbriatus* (Fischer, 1853); Eli, *Eucyclops lilljeborgi* (Sars G.O., 1918); Ema, *Eucyclops macrurus* (Sars G.O., 1863); Ese, *Eucyclops serrulatus* (Fischer, 1851); Mle, *Mesocyclops leuckarti* (Claus, 1857); Bec - *Bryocamptus echinatus* (Mrázek, 1893); Acr, *Attheyella crassa* (Sars G.O., 1863); Nhi, *Nitokra hibernica* (Brady, 1880); Bho, *Bryocamptus hoferi* (Van Douwe, 1908); Bmi, *Bryocamptus minutus* (Claus, 1863); Eri, *Epactophanes richardi* Mrázek, 1893.

Tab. 2. Description of the dataset available in GBIF with specific information relative to column labels and respective description in the csv file.

Column label	Column description
eventID	Unique identifier for the record within the dataset (SamplingSite:HabitatReplicate)
occurrenceID	Unique identifier for the record within GBIF database (CNR:IRSA:SampligSite:HabitatReplicate:Species)
basisOfRecord	The specific nature of the data record (PreservedSpecimen)
eventDate	The sampling date
scientificName	The full scientific name
taxonRank	Taxonomic rank of the most specific name in the scientific name
kingdom	Full scientific name of the kingdom in which the taxon is classified
phylum	Full scientific name of the phylum in which the taxon is classified
subphylum	Full scientific name of the subphylum in which the taxon is classified
class	Full scientific name of the class in which the taxon is classified
order	Full scientific name of the order in which the taxon is classified
family	Full scientific name of the family in which the taxon is classified
subfamily	Full scientific name of the subfamily in which the taxon is classified
genus	Full scientific name of the genus in which the taxon is classified
species	Full scientific name of the species in which the taxon is currently classified
decimalLatitude	Geographic latitude (in decimal degrees, using the spatial reference system in geodeticDatum)
decimalLongitude	Geographic longitude (in decimal degrees, using the spatial reference system in geodeticDatum)
geodeticDatum	Spatial Reference System (SRS) to locate geographical water bodies or their habitats (WGS84)
countryCode	The standard code of the country in which the sampling location occurs (IT, CH)
Locality	The specific description of the place (LakeMaggiore)
organismQuantity	Value for the quantity of organism
organismQuantityType	Type of quantification system used for the quantity of the organisms (individuals)

The acronym in the column “eventID” is a combination of the acronyms of sampling-sites, habitats and replicate numbers separated by colon (see Tab. 1 for abbreviation), while the column “occurrenceID” contains information about publisher, habitat, replicate numbers and species.

Data set citation: Tabilio Di Camillo A, Boggero A, Galassi D M P, Kamburska L, Fiasca B, Di Lorenzo T (2023). Benthic copepod records in the littoral area of Lake Maggiore. Version 1.6. Consiglio Nazionale delle Ricerche - Istituto di Ricerca sulle Acque. Occurrence dataset <https://doi.org/10.15468/3w9bw4> accessed via GBIF.org

Distribution (permanent link): GBIF: <https://www.gbif.org/dataset/78e81992-16c2-4644-9820-4b0dbe19f2a2>

Data format version: 1.6

Character encoding: UTF-8

Data format: csv

Date of creation: 10 February 2023

Date of last revision: 17 February 2023

Date of publication: 16 February 2023

Language: English

License of use: any user can access and use at no cost (CC-BY 4.0). When utilizing the data, we kindly ask the

users to credit the authors and link back to the original dataset GBIF (<https://doi.org/10.15468/3w9bw4>), as well as to consider the authors of the data set for co-authorship. Stakeholders can get in touch with the authors using the information in the metadata should they need more details.

Update policy: GBIF policy rules. Future changes to the dataset due to quality control activities might change its content or structure.

Metadata language: English

Metadata managers: Tiziana Di Lorenzo (tiziana.dilorenzo@cnr.it), Lyudmila Kamburska (lyudmila.kamburska@irsa.cnr.it)

Geographic coverage: Lake Maggiore, north-western Italy. Data were georeferenced directly on site according to WGS 84 datum

Bounding box: latitude N 45.722039 - 46.179841, longitude E 8.481792 - 8.860820

Biogeographic region: Alpine (EEA, 2017)

Country: Italy, Switzerland

Locality: Lake Maggiore

Geographical subdivisions: Lombardy and Piedmont regions (Italy); Canton Tessin (Switzerland)

Quality control: for geographic information, Google Maps

was used to verify the accuracy of the coordinates. The dataset's geographic coordinate format, locations that fall inside state or provincial borders, and anomalous ASCII characters were examined.

Taxonomic coverage: the data set represents the two dominant orders of freshwater copepods, Harpacticoida and Cyclopoida, of the meiobenthic metazoan assemblages of the littoral of Lake Maggiore. Taxonomic ranks: Data from species, genus, subfamily, family, order, class, subphylum, phylum and kingdom rank were included in the dataset.

Study extent: The dataset includes only occurrence records and number of individuals (number of copepods/150 meiobenthic metazoan individuals) of harpacticoid and cyclopoid species.

Sampling design: copepod sampling was carried out using the techniques described in Cifoni *et al.* (2022). A 625 cm² submerged littoral area was disturbed by foot for 30 sec. A hand net with a mesh of 60 µm over the disturbed area was dragged to gather the displaced copepod individuals (Cifoni *et al.*, 2022; Boggero *et al.*, 2022). After being collected, the semi-quantitative samples were stored in bottles with a 70% ethanol solution (Suarez-Morales, 2015) until they were sorted in the laboratory. Samples were standardized in the laboratory by sorting the sediments and selecting 150 meiobenthic individuals with a glass pipette under a stereomicroscope at 16× magnification according to Cifoni *et al.* (2022).

Taxonomic methods: Copepods were identified to species level following literature (Kiefer, 1960; Boxshall and Halsey, 2004; Dussart and Defaye, 2006). Species identification was performed by dissecting adult harpacticoid and cyclopoid individuals. Using a tungsten needle, the adult specimens were removed from the sample and dissected individually on a microscope slide in a drop of glycerol.

Taxon specialist: Diana Maria Paola Galassi

Basis of record: preserved specimens

Quality control: validation for taxonomic consistency was performed using World Register of Marine Species (WoRMS Editorial Board, 2023)

Management details

Project title: First dataset of benthic copepods in the littoral areas of a lake subject to human-induced water level fluctuations_INTERREG_PVT

Database managers: Tiziana Di Lorenzo, Lyudmila Kamburska

Temporal coverage: Data covered August and September 2019, from July to September 2020 and July 2021

IT specialists: Agostina Tabilio Di Camillo, Lyudmila Kamburska

Funding grants: Data were gathered within the framework

of the Project Interreg “Parchi Verbano Ticino” (PVT, ID: 481668) aimed to grasp the consequences of water level management on the littoral lake ecosystems.

DATA AND CODE AVAILABILITY

All georeferenced data are available at GBIF: <https://doi.org/10.15468/3w9bw4>.

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REFERENCES

- Boggero A, Kamburska L, Zaupa S, Ciampittiello M, Paganelli D, Cifoni M, Rogora M, Di Lorenzo T, 2022. Sampling and laboratory protocols to study the effects of water-level management on the littoral invertebrate fauna in deep and large temperate lakes. *J. Limnol.* 81:2073.
- Boxshall GA, Defaye D, 2008. Global diversity of copepods (Crustacea: Copepoda) in freshwater. *Hydrobiologia* 595: 195–207.
- Boxshall GA, Halsey SH, 2004. An introduction to copepod diversity, 166 (Part I). Ray Society, London: 421 pp.
- Cifoni M, Boggero A, Rogora M, Ciampittiello M, Martínez A, Galassi DMP, Fiasca B, Di Lorenzo T, 2022. Effects of human-induced water level fluctuations on copepod assemblages of the littoral zone of Lake Maggiore. *Hydrobiologia* 849:3545–3564.
- Cifoni M, Boggero A, Galassi DMP, Di Lorenzo T, 2021. An overview of studies on meiofaunal traits of the littoral zone of lakes. *Water* 13:473.
- Commito JA, Tita G, 2002. Differential dispersal rates in an intertidal meiofauna assemblage. *J. Exp. Mar. Biol. Ecol.* 268:237–256.
- Dole-Olivier MJ, Galassi DMP, Marmonier P, Creuzé des Châtelliers M, 2000. The biology and ecology of lotic microcrustaceans. *Freshwater Biol.* 44:63–91.
- Dussart BH, Defaye D, 2006. World directory of Crustacea Copepoda of inland waters. II. Cyclopiformes. Backhuys Publishers, Leiden: 354 pp.

- Foy MS, Thistle D, 1991. On the vertical distribution of a benthic harpacticoid copepod: field, laboratory, and flume results. *J. Ex. Mar. Biol. Ecol.* 153:153–164.
- Giere O, 2009. Meiobenthology. The microscopic motile fauna of aquatic sediments. Springer-Verlag, Berlin: 527 pp.
- Kiefer F, 1960. [Beiträge zur Copepodenkunde (XX)]. [Article in German]. *Zool. Anz.* 165:37–45.
- Leitão E, Ger KA, Panosso R, 2018. Selective grazing by a tropical copepod (*Notodiaptomus iheringi*) facilitates *Microcystis* dominance. *Front. Microbiol.* 9:301.
- Muschiol D, Marković M, Threis I, Traunspurger W, 2008. Predator-prey relationship between the cyclopoid copepod *Diacyclops bicuspidatus* and a free-living bacterivorous nematode. *Nematology* 10:55–62.
- Rollwagen-Bollens G, Bollens SM, Gonzalez A, Zimmerman J, Lee T, Emerson J, 2013. Feeding dynamics of the copepod *Diacyclops thomasi* before, during and following filamentous cyanobacteria blooms in a large, shallow temperate lake. *Hydrobiologia* 705:101–118.
- Sarvala J, 1986. Patterns of benthic copepod assemblages in an oligotrophic lake. *Ann. Zool. Fenn.* 23:101–130.
- Sarvala J, 1998. Ecology and role of benthic copepods in northern lakes. *J. Mar. Syst.* 15:75–86.
- Schmid-Araya JM, Schmid PE, 2000. Trophic relationships: integrating meiofauna into a realistic benthic food web. *Freshwater Biol.* 44:149–163.
- Schmieder K, 2004. European lake shores in danger—Concepts for a sustainable development. *Limnologica* 34:3–14.
- Stoch F, 2001. Mapping subterranean biodiversity: structure of the database, mapping software (CKMAP), and a report of status for Italy. *Karst Waters Institute Special Publication* 6:29–35.
- Suárez-Morales E, 2015. Class Maxillopoda, p. 709–755. In: J.H. Thorp and D.C. Rogers (eds.), Thorp and Covich's freshwater invertebrates. Academic Press, Cambridge: 2015.
- Tabilio Di Camillo A, Boggero A, Galassi DMP, Kamburska L, Fiasca B, Di Lorenzo T, 2023. Benthic copepod records in the littoral area of Lake Maggiore. Version 1.6. Consiglio Nazionale delle Ricerche - Istituto di Ricerca sulle Acque. Occurrence dataset Available from: <https://doi.org/10.15468/3w9bw4>
- Vadeboncoeur Y, McIntyre PB, Vander Zanden Mj, 2011. Borders of biodiversity: Life at the edge of the world's large lakes. *BioScience* 61:526–537.
- Wieczorek J, Bloom D, Guralnick R, Blum S, Döring M, Giovanni R, Robertson T, Vieglaiss D, 2012. Darwin Core: an evolving community-developed biodiversity data standard. *PLoS One* 7:e29715.
- WoRMS, 2023. Integrated Marine Information System (IMIS). Accessed 2023-02-14. Available from <https://www.marine-species.org/imis.php?dasid=1447&doiid=170>