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Data Descriptor

Dataset of Contamination (2009–2022) Legacy Contaminants (PCB and DDT) in Zooplankton of Lake Maggiore (CIPAIS, International Commission for the Protection of Italian-Swiss Waters)

Roberta Bettinetti [1,*], Roberta Piscia [2,*], Marina Manca [2], Silvana Galassi [3], Silvia Quadroni [4], Carlo Dossi [4], Rossella Perna [5], Emanuela Boggio [5], Ginevra Boldrocchi [1], Michela Mazzoni [5] and Benedetta Villa [5]

1 Human Sciences and Innovation for the territory Department (DISUIT), University of Insubria, Via S. Abbondio, 22100 Como, Italy; ginevra.boldrocchi@uninsubria.it
2 CNR—IRSA Largo Tonolli, 28922 Verbania, Italy; marina.manca@irsa.cnr.it
3 Biology Department, University of Milan, Via Celoria, 20122 Milan, Italy; silvan.galassi@gmail.com
4 Theoretical and Applied Science Department (DISTA), University of Insubria, Via Dunant, 21100 Varese, Italy; silvia.quadroni@uninsubria.it (S.Q.); carlo.dossi@uninsubria.it (C.D.)
5 Department of Applied Science and Technology (DISAT),University of Insubria, Via Valleggio, 22100 Como, Italy; rossella.perna@uninsubria.it (R.P.); boggioe@gmail.com (E.B.); michela.mazzoni87@gmail.com (M.M.); benedetta.villa@uninsubria.it (B.V.)
* Correspondence: roberta.bettinetti@uninsubria.it (R.B.); roberta.piscia@cnr.it (R.P.)

Abstract: In this paper, we describe a 13-year (2009–2022) dataset of legacy POP concentrations (DDT_{tot} and $sumPCB_{14}$ from 2016 isomers and congeners concentrations are also reported) in the planktonic crustaceans of Lake Maggiore (≥450 µm size fraction). The data were collected in the framework of a monitoring program finalized to assess the presence of pollutants in the lake biota, including zooplankton organisms directly preyed by fish. The data report both concentration of DDT_{tot} and $sumPCB_{14}$ in the zooplankton and the standing stock density and biomass of the population in each season. The dataset allows for detecting changes in the concentration over the long term and within a year, thus providing evidence for the seasonal and the plurennial variations in the presence of these pollutants in the lake. They also provide a basis for further studies aimed at modeling paths and the fate of persistent organic pollutants, for which the amount of toxicants stocked in the zooplankton compartment linked to fish is a crucial estimate.

Dataset: https://doi.org/10.5281/zenodo.8109373

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Keywords: persistent organic pollutants (POPs); freshwater zooplankton; seasonal contamination; long term data; legacy contaminants

Citation: Bettinetti, R.; Piscia, R.; Manca, M.; Galassi, S.; Quadroni, S.; Dossi, C.; Perna, R.; Boggio, E.; Boldrocchi, G.; Mazzoni, M.; et al. Dataset of Contamination (2009–2022) Legacy Contaminants (PCB and DDT) in Zooplankton of Lake Maggiore (CIPAIS, International Commission for the Protection of Italian-Swiss Waters). *Data* **2023**, *8*, 152. https://doi.org/10.3390/data8100152

Academic Editor: Vladimir Sreckovic

Received: 8 September 2023
Revised: 29 September 2023
Accepted: 10 October 2023
Published: 12 October 2023

1. Summary

Lake Maggiore, located in the subalpine region between Italy and Switzerland (80% and 20% of the surface area), is a deep (mean depth: 178.9 m; maximum depth: 370 m) and large (surface area: 213 km^2) lake. The lake rarely undergoes complete vertical mixing; in fact, it is classified as holo-oligomictic [1–3]. Lake Maggiore has 33 tributaries and one outlet, the Ticino River. Presently it is oligotrophic, after a successful eutrophication reversal due to sewage treatment plants and use of phosphorus-free detergents. A monitoring program on POPs in fish and in sediment cores was started after the discovery of fresh DDT discharge into the lake. The program was later extended to include a wide range of POPs, not least the

PCBs. These compounds were almost undetectable in the water column; hence, after some years of monitoring different components of the lake environment, zooplankton became one of the crucial biomonitoring tools able to rapidly incorporate and transfer contaminants through the food web [4–7].

2. Data Description

The present dataset (on excel file) consists of 50 samples with concentrations (expressed as ng g^{-1} d.w.) of DDT_{tot} and $sumPCB_{14}$ from 2009 to 2022 of zooplankton, belonging to the size fraction ≥450 µm and collected seasonally. Starting from 2016, we report not only the total sum but also the different congeners and isomers of DDT and each concentration of analyzed PCBs, which allow us to clarify better the age and origin of these contaminants. For the same years, the lipidic content of samples is also reported, in addition to the years 2011 and 2014.

We also provide the Standing Stock Density (SSD; ind m^{-3}) and Standing Stock Biomass (SSB; µg m^{-3}) of pelagic crustacean plankton organisms belonging to the already mentioned size fraction.

The dataset reports seasonal and plurennial variations in toxicants' concentrations, along with the zooplankton taxa composition, thus allowing us to estimate the potential contribution of different taxa to the transfer of contaminants to the fish [8].

3. Methods

3.1. Sampling of Zooplankton and Microscopical Analysis

The pelagic sampling station (45°58′30″ N; 8°39′09″ E) was located in the area of maximum depth (370 m) of the lake basin (Figure 1). Zooplankton samples were collected each season from 2009 to 2022. Samplings were performed by towing vertically, from 50 m depth to the surface, a plankton sampler (Ø = 59 cm) equipped with a nylon net of 450 µm of mesh size, in order to avoid collection of large phytoplankton colonies. Sampling the upper 50 m is representative of the net zooplankton population [9]. In fact, only during complete vertical mixing events, which are very rare events, the organisms are homogeneously distributed throughout the entire water column [10]. Samples for POP analyses were filtered on GF/C (1.2 µm pore size glass fiber filter) and were freeze-dried. A second sample, concentrated in place in 100 mL 96% ethanol, was used for microscopic counts (of at least 10% of the total volume) and the estimate of standing stock density (SSD; ind m^{-3}).

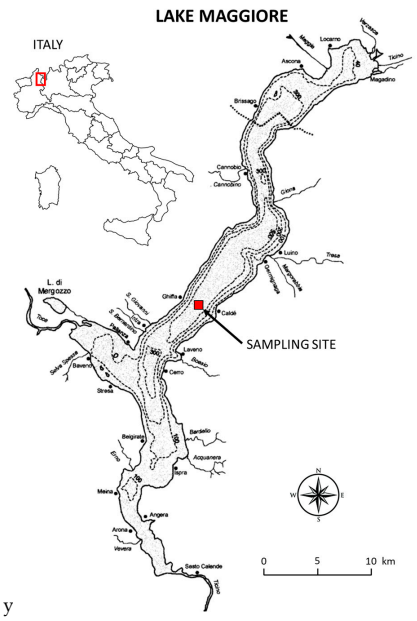

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Figure 1. Map of Lake Maggiore. The red square indicates the sampling station; the red empty rectangle indicates the area where Lake Maggiore is located in Italy.

Individual body lengths of at least 25 individuals/taxon were used to apply taxon-specific length–weight regression equations [11,12], from which the total standing stock biomass (SSB; μg m^{-3}) was estimated for each sampling date.

3.2. Chemical Analysis of DDT and PCB

Organochlorine compounds (OC) were analyzed following the method described in [5]. After zooplankton freeze-drying, glass fiber thimbles (19 mm I.D., 90 mm length, Whatman, Maidstone, UK) with about 0.5 g were extracted in Soxhlet (ECO 6 Thermoreactor, Velp Scientifica, Usmate, Italy) for 2 h in a n-hexane:acetone (1:1) solution (pesticide analysis grade, Carlo Erba Reagents s.r.l, Cornaredo, Italy). The lipid content was gravimetrically determined, and then digested with 2 mL of H_2SO_4 (98%, Carlo Erba Reagents s.r.l, Cornaredo, Italy) for 10 h. Then, a clean-up on a Florisil® column (40 mm × 7 mm I.D.) with 25 mL of an 85:15 mixture of n-hexane and dichloromethane (pesticide analysis grade, Carlo Erba Reagents s.r.l, Cornaredo, Italy) followed. Finally, the sample was concentrated to 0.5 mL. Analyses were carried out using GC (Top 8000, Carlo Erba Instruments, Rodano, Italy) with an on-column injection system (1 μL), equipped with a WCOT fused silica CP-Sil-8 CB column (50 m × 0.25 mm I.D., film thickness 0.25 μm, Varian Inc., Palo Alto, CA, USA) and an electron capture detector (ECD 80, Carlo Erba Instruments, Rodano, Italy). The quantification was carried out with external standards for DDT and PCB (Custom Pesticide Mix o2si, USA, Custom PCB Calibration Mix (o2si, USA) and Aroclor 1260 (Alltech, Nicholasville, KY, USA)). DDT analyzed were pp′DDT, op′DDT′, pp′DDD, op′DDD, op′DDE, and pp′DDE and PCB congeners PCB 18, 28 + 31, 44, 52, 101, 118, 149, 138, 153, 170, 180, 194, and 209. The limit of detection for zooplankton was 0.1 ng/g dry. For Q.A., triplicate analyses were carried out on the standard reference materials SRM NIST-1947 "Lake Michigan Fish Tissue" and NIST-1946 "Lake Superior Fish Tissue" for DDT homologues and PCB residues, respectively. The percentage recoveries of DDT were between 106.2 ± 3% and 107.5 ± 4%, while those for PCB were from 91.3% (±1.1%) to 102.2% (±1.6%).

Author Contributions: Conceptualization, R.B., R.P. (Roberta Piscia), M.M. (Marina Manca), and S.G.; methodology, R.P. (Roberta Piscia), M.M. (Marina Manca), S.G., C.D. and R.P.; formal analysis, R.B., R.P. (Roberta Piscia), M.M. (Marina Manca) and S.G.; investigation, R.P. (Roberta Piscia), M.M. (Marina Manca), S.G., C.D., R.P. and all the other authors; funding acquisition, R.B., R.P. (Roberta Piscia), M.M. (Marina Manca), S.G.; data curation, C.D. and R.P. (Rossella Perna); writing—original draft preparation, M.M. (Marina Manca), R.P. (Roberta Piscia) and R.B.; writing—review and editing, M.M. (Marina Manca), R.P. (Roberta Piscia) and R.B. All authors have read and agreed to the published version of the manuscript.

Funding: The research was funded by CIPAIS (International Commission for the Protection of Italian-Swiss Waters; I-CH DDT GAE P0000582).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are openly available in the Zenodo repository at https://doi.org/10.5281/zenodo.8109373 (accessed on 10 October 2023).

Acknowledgments: The authors thank all the CIPAIS colleagues involved over the years for their great collaboration on any occasions. In memory of Letizia Garibaldi, for her love of lakes and teaching us how to study them.

Conflicts of Interest: The authors declare no conflict of interest.

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