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Data Article

Dataset of a study about the impact of a micro-sewage effluent on the benthic macroinvertebrate community in a small Apennine creek (NW Italy)

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A B S T R A C T

Concerning the impact of organic contamination, most studies focus on the main river courses, which are affected by large wastewater plants and intensively urbanized areas, while a large part of a river's catchment area is made up of small streams flowing through rural or forested areas. As a result, the impact of even small sources of organic load on small systems is often not analysed. This study investigated the impact of a small sewage source on the aquatic environment of the Caramagna Creek (NW Italy). At the study site, the creek receives an effluent sewer from a small cluster of houses. To evaluate the impact of this point source of pollution, we estimated macroinvertebrate community composition and abundance monthly from January 2005 to March 2006 in two stations, located respectively 50 m upstream and 50 m downstream of the sewer pipe. At the same time, main physicochemical parameters, microbiological data, and chlorophyll-a concentration were assessed. These data aim to inspire additional research, particularly in addressing the

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implications of often overlooked small impacts occurring in small rivers, which can have an enormous impact given the dendritic organisation of the hydrographic network and the multiplicative effect along the river system. These results are especially relevant in the context of evolving river dynamics influenced by decreasing flows, resulting in a diminution in dilution capacity and thus greater fragility of river ecosystems.
Moreover, if we consider only the upstream site, this dataset holds important potential related to non-impacted macroinvertebrate communities, constituting an important reference because it integrates macroinvertebrate community data with different environmental data, from granulometry to in-stream productivity, from chemical-physical to microbiological data.

Specifications Table

Subject	Environmental Science - Ecology
Specific subject area	Benthic macroinvertebrate monitoring upstream and downstream of a sewage pipe, deriving from a small cluster of houses, in a small rural creek (Caramagna - NW Italy), with related collection of chemical-physical, environmental, microbiological data, and chlorophyll-a concentration.
Data format	Raw
Type of data	Table
Data collection	Macroinvertebrates:Structure and functional composition of benthic community, sampled with a 20 × 20 cm Surber sampler (255 µm mesh size).Physicochemical-microbiological parameters: - Eijkelkamp 13.14 and 18.28 instruments: depth (cm), velocity (m/s), temperature (°C), conductivity (µS/cm), dissolved oxygen (mg/L) and pH - Granulometry: determined by assessing the relative percentage composition at each sampling point. - Laboratory analysis [2]: Total P (M.598), COD (M0.14), $NH^+{}_4$ (M.589), $NO^-{}_3$ (M.020), anionic tensioactives (M.268), and *Escherichia coli* (M.001). - Benthic chlorophyll-a concentration: determined via spectrophotometry (UV/Vis DUSERIES 500 Beckman) following extraction in 90 % acetone. - The macroinvertebrates collected were sorted and identified in the field. In instances of uncertainty, specimens were preserved in 75 % alcohol and examined using a Nikon SMZ 1500 stereomicroscope and some taxonomic identification manuals [3–7].
Data source location	Institution: Department of Life and Environment Science, University of Piemonte Orientale City/Town/Region: Cassinelle, Alessandria, Piemonte Country: Italy GPS coordinates: 44° 36’ N–8°32’ E
Data accessibility	The dataset described in this data paper is accessible as open file in the INRAE CARRTEL Dataverse repository as single Excel file. Repository name: https://entrepot.recherche.data.gouv.fr/dataverse/carrtel Direct URL to data: https://doi.org/10.57745/S06RSH
Related research article	[1] T. Bo, S. Fenoglio, Impacts of a micro-sewage effluent on the biota of a small Apennine creek. J. Freshw. Ecol. 26 (2011) 537-545. https://doi.org/10.1080/02705060.2011.583400

1. Value of the Data

- This dataset is related to an often overlooked phenomenon, i.e. the impact of small point source of organic pollution on small lotic systems, because most studies addressed organic pollution in large rivers, flowing in anthropized and urbanized area.
- Studies about organic pollution in small mountainous or hilly streams can be of great interest in the context of the climate change, when decreasing flows result in a diminution in dilution capacity and self-purification capacity.
- Considering only the upstream, unpolluted section, this dataset holds important potential for research focusing on stream macroinvertebrate community structure and functional organisation in relation to selected microhabitat characteristics (water column depth, water velocity, substrate granulometric composition)
- This subset collected between 2005 and 2006 could serve as historical data for macroinvertebrate communities, integrated with chemical-physical and microbiological data. This historical perspective offers valuable insights for understanding ecosystem dynamics and the mid-term (10–15 years) response of the biological community to local stressors, as well for assessing the long-term impact of environmental factors as point of comparison against which more recent and future data can be compared in the context of global change.
- These data can be analysed with univariate, bivariate, and multivariate methods. It can be used for comparison with other systems undergoing the same water quality degradation and for larger meta-analysis.

2. Background

Sources of organic pollution, one of the most diffuse and prevalent causes of aquatic ecosystem degradation, should always be taken into account, regardless of their size and the order of the river they affect [8,9]. This dataset is related to a low-order Apennine creek impacted by organic pollution originating from a small settlement [1] in a rural area of NW Italy. Usually, Apennine watercourses harbor rich and diverse biological communities [10–12], hosting numerous rare and interesting taxa [13,14]. The focus of the original study [1] was to examine the impact of the sewage effluent on the structure and functional composition of the macroinvertebrate community and on the photosynthetic community measured by the amount of benthic chlorophyll-a. In the current scenario of climate change, the rapid reduction in water availability will probably cause a decrease in pollutant dilution, so that studies assessing the effects of effluent waters will become increasingly necessary and valuable. We are confident that this dataset could represent an important reference and could be useful for further investigations contributing to the ongoing discourse on the ecological implications of wastewater discharge in the face of future environmental challenges.

3. Data Description

The dataset is available for download from the INRAE CARRTEL Dataverse data repository. Data are stored in a single Excel file, which consists of one data sheet (named “complete_DATA”) and one summary table (named “summary”). The primary sheet contains the dataset, where each sample (Surber and related measurements) is presented in rows. The column "sample_point" refers to the sample identification, including "S" for upstream sampling or "M" for downstream sampling, the number (1,2,...) of the progressive sample, and the sampling date (represented by the day followed by the first letters of the month). The measured parameters are organised in columns, accompanied by their respective units (in brackets). Chemical and microbiological data (conductivity, DO, temperature, TP, COD, $NH^{+}{}_{4}$, $NO^{-}{}_{3}$, pH, anionic tensioactives and *E. coli*), physical data (depth, velocity, and substrate % granulometry), and chlorophyll-a

Table 1
An overview of the data collected for each group of variables and the sampling dates.

	Total of macroinvertebrate Surber samples	Data of sampling (day, month, and year)	Chemical and microbiological sampling	Physical data sampling	Chlorophyll-a
Upstream	109	04/01/2005, 12/01/2005, 18/01/2005, 31/01/2005, 10/03/2005, 17/03/2005, 31/03/2005, 27/04/2005, 05/05/2005, 07/06/2005, 21/07/2005, 21/09/2005, 26/11/2005, 27/12/2005, 07/02/2006, 02/03/2006,	6	109	34
Downstream	47	17/03/2005, 31/03/2005, 27/04/2005, 05/05/2005, 07/06/2005, 21/07/2005, 27/12/2005, 07/02/2006, 02/03/2006	6	47	30

concentrations are reported. Benthic invertebrate taxa are arranged in columns, with each row providing the abundance (i.e. the number of individuals no/ind) of the corresponding taxon in the sample. On the right of taxa, four columns present the total abundance of macroinvertebrates in the sample (N), the taxonomic richness (S), and the abundance and richness of taxa belonging to Ephemeroptera, Plecoptera, and Trichoptera (named EPTN and EPTS, respectively). The last five columns indicate the Functional Feeding Group to which the taxon belongs: scrapers (Sc), shredders (Sh), collector-gatherers (Cg), filterers (F), and predators (P) [15]. The values are individually listed for each sample, enhancing accessibility, and facilitating comprehensive analyses of the dataset. Overall, 156 macroinvertebrate community samples were collected during the study period (Table 1), accounting for a total of 62463 individuals belonging to 107 different taxa. Missing data and values below the limit of quantification are respectively identified by the code "N/A" for non-available data and "<" for values below the detection limit (for example <0.05). We carried out a higher number of Surber samples in the upstream section because of its higher biodiversity, while in the downstream section with a smaller number of samples, we got a precise picture of the benthic community.

4. Experimental Design, Materials and Methods

4.1. Experimental design

This study was conducted in the Caramagna Creek, a small tributary of the Bormida River, located in North-Western Italy (44°36' N–8°32' E; 280 m a.s.l.). The sampling site was strategically selected to investigate the impact of organic pollution originating from a small cluster of houses, which divides the creek into an upstream, natural section characterized by an excellent water quality and a downstream, impacted section. In each section, monthly sampling was carried out, respectively 50 m upstream and 50 m downstream the sewer pipe from January 2005 to March 2006.

Environmental data, such as temperature, water depth, velocity, and % granulometry were measured as well as chemical parameters including conductivity, dissolved oxygen, temperature, total Phosphorus, Chemical Oxygen Demand, pH, $NH^{+}{}_{4}$, $NO^{-}{}_{3}$, anionic tensioactives. The microbiological parameter *E. coli* (cfu/mL) was measured as proxy for level of anthropization and benthic chlorophyll-a concentrations as proxy of primary productivity.

5. Materials and methods

Macroinvertebrate communities were collected using a 20 × 20 cm Surber sampler with a 255 µm mesh. In the laboratory, all organisms were meticulously counted and identified at the genus level and in some cases at the species or family levels. To analyse the functional composition, we used the following functional feeding groups: scrapers (Sc), shredders (Sh), collector-gatherers (Cg), filterers (F), or predators (P) according to Merritt and Cummins (1996) [15]. Specimens were identified by using a SMZ 1500 NIKON microscope and some taxonomic identification manuals [3–7]. Key physicochemical parameters - depth (cm), velocity (m/s), temperature (°C), conductivity (µS/cm), dissolved oxygen (mg/L) and pH - were measured in the field using portable Eijkelkamp 13.14 and 18.28 instruments (three replicates, calibration following instructions in the Eijkelkamp Digital Flowmeter and P2.73 Manuals). Concurrently, benthic chlorophyll-a concentrations were determined by placing ceramic tiles in the stream reach, leaving them in place for one month, and subsequently brushing to collect attached material. Chlorophyll-a concentrations were quantified by collecting the attached material on Whatman GF/F, 0.45 μn filters, adding 15 ml of buffer solution 90 % acetone for extraction in the dark for 24 h, and measured by spectrophotometry following the methodology outlined by Steinman and Lamberti (1996) and a UV/vis DUSERIES 500 Beckman [16].

Water samples were collected from the sub-surface using acid-washed polythene bottles or sterile glass bottles. In the laboratory, additional chemical and bacteriological properties of the water were assessed using A.P.A.T. - I.R.S.A. (2003) [8] methods. Measurements included TP (M.598), COD (M0.14), $NH^{+}{}_{4}$ (M.589), $NO^{-}{}_{3}$ (M.020), anionic tensioactives (M.268), and *E. coli* (M.001) assessed using the method APAT-CNR-IRSA 7030C [2].

Limitations

A limitation of this study could be represented by the fact that we assess the importance of organic contamination both upstream and downstream of the sewer pipe without direct testing for total or dissolved organic carbon, or its surrogates such as SUVA. However, we used other indicators of faecal organic contamination, such as COD and *E. coli* abundance, as proxies. Additionally, the potential influence of non-point sources within the watershed and in-stream total organic carbon (TOC) sources were not specifically accounted in the analysis.

Ethics Statement

The authors have read and follow the ethical requirements for publication in Data in Brief and confirm that the current work does not involve human subjects, animal experiments, or any data collected from social media platforms.

Data Availability

Dataset of a study about the impact of a micro-sewage effluent on the benthic macroinverte brate community in a small Apennine creek (NW Italy) (Original data) (Dataverse).

CRediT Author Statement

Giorgia Ercole: Conceptualization, Data curation, Writing – original draft, Writing – review & editing; **Anna Marino:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing; **Stefano Fenoglio:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing; **Serena Rasconi:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing; **Tiziano Bo:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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