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DATAPAPER: An historical and geographic data set on the distribution of macroinvertebrates in Italian mountain lakes

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Keywords: artificially extended lakes, dataset distribution, high altitudes, macroinvertebrates, natural lakes, reservoirs.

SUMMARY

Macroinvertebrates play a key role in freshwater food webs, acting as major links between organic matter resources, primary consumers (such as bacteria), and secondary consumers (e.g. fish, amphibians, birds, and reptiles). In this paper we present a data set encompassing all geographic and historical data available on macroinvertebrates of the Italian mountain lakes from 1902 to 2016. The data set, divided per Italian mountain range (Alps and Apennines) and administrative region, covers more than a century of studies of many foreign and Italian scientists. The data set includes 2372 records and shows macroinvertebrate occurrence data in 176 Alpine and in 13 Apennine lakes, of which 178 of natural origin, 5 reservoirs, and 6 artificially extended. The data set lists 605 taxa, updated on the basis of their current taxonomic position. Only 353 taxa are identified at species level, highlighting the still poorly investigated biodiversity of Italian mountain lake macroinvertebrates. Since they function as key elements to characterize lake ecological status, our data set emphasizes the huge taxonomic effort that still has to be undertaken to fully characterize these ecosystems. The data set is available in csv (comma-separated values) format.

INTRODUCTION

Mountain lakes (and their fauna) are peculiar and vulnerable elements scattered across the high altitude landscapes. They are mainly affected by direct and indirect human impacts, like global climatic change, eutrophication, acidification, nitrification, tourism, hydro-power generation, water abstraction, fish-stocking, and grazing (Catalan et al. 2006, Marnezy 2008, Martinez-Sanz et al. 2012, Rogora et al. 2013). Generally, the severe environmental conditions characterizing these water bodies limit the presence of macroinvertebrates, simplifying their biological assemblages, which remain more complex and diverse along the littorals. Aside from their biodiversity, they are still the least investigated surface water ecosystems in Italy, mainly because of the complexity of sampling procedures and the troublesome taxonomic identification of species. Furthermore, due to their small dimensions, they are not included under the monitoring programs of the Water Framework Directive (EU 2000).

Macroinvertebrates play an important role in the monitoring of environmental evolution of mountain lakes due to their reliability and utility in long-term studies (Biggs et al. 2005, Oertli et al. 2008), but their taxonomic knowledge is still fragmented and limited. Macroinvertebrates include immature and adult stages of many different types of invertebrates, such as aquatic insects, crustaceans, mollusks, annelids, flatworms, and cnidarians. They are considered good indicators of ecological status (Allan and Castillo 2007), and thus they are broadly used as warning sentinels of environmental changes. Therefore, to promote targeted conservation and restoration strategies on mountain lakes, we need firstly a sound knowledge on the presence and distribution of species there inhabiting.

Although several data sets on freshwater macroinvertebrates are already available at Italian level (e.g. Freshwater Biodiversity Data Portal, National Network of Biodiversity - <http://data.freshwaterbiodiversity.eu/metadb/metaDBfts/index.php>, Nature 2000 - <http://www.minambiente.it/pagina/rete-natura-2000>, Checklist of the Italian Fauna - <http://www.faunaitalia.it/checklist/>, LifeWatch Italy - <http://www.servicecentrelifewatch.eu/web/lifewatch-italia/catalogue-of-resources>, etc.), data and metadata reported on mountain lakes are scattered

and incomplete. In particular, data on high altitude or mountain lakes fauna over time do not exist at present. The aims of this work are therefore i) to provide the first checklist of macroinvertebrates occurring in Italian mountain lakes, including data on their geographic distribution, and ii) to update their taxonomy with currently accepted names following Fauna Europaea (<https://fauna-eu.org>) useful for taxonomists, students, researchers, and water managers.

RESULTS

This data set includes 605 taxa of macroinvertebrates, distributed among five phyla (Annelida, Arthropoda, Cnidaria, Mollusca, and Platyhelminthes) (Table 1), ten classes (Arachnida, Bivalvia, Gastropoda, Hirudinea, Hydracarina, Insecta, Leptolida, Malacostraca, Oligochaeta, “Turbellaria”), 28 orders, 104 families, 257 genera, and 353 species occurring across ten Italian administrative regions, in 176 Alpine and 13 Apennines lakes (Table 2).

Table 1. Number of records reported for each phylum.

Phylum	Records
Annelida	320
Arthropoda	1812
Cnidaria	2
Mollusca	209
Platyhelminthes	29

Summary statistics

The data set consists of 29 columns (Table 3) per 2372 records. The first column reports the ID Code of each record. The successive 8 columns are a rank-based taxonomical classification including the categories of Kingdom, Phylum, Class, Superorder, Order, Family, Subfamily, Tribe, when known and available. Then, eight columns report the Accepted genus name, Accepted species epithet, Accepted taxon name, Author/s and date of 1st description of the species, Level of classification (updated), Original cited genus, Original cited species epithet, Original cited species name. The remaining twelve columns refer to: Frequency data format (presented by each paper and expressed as presence, absolute abundance, density, relative abundance, or a combination of these), Year of publication, Record reference, Mountain range, Administrative region,

Lake name, Alternative lake name (e.g. it can be the translation of the first lake name into the second most used language of the administrative region, or another name by which the lake is known), Type of

lake (either natural, reservoir, or artificially extended), Latitude N, Longitude E (as WGS 84 datum), Altitude (as m a.s.l.), Maximum depth (in meters).

Table 2. Number of records distributed among mountain range, administrative region, altitudinal range, and number of lakes for the Alps and the Apennines.

Mountain range	Administrative region	Altitudinal range	Lakes	Records
Alps	Liguria	1050	1	3
	Lombardia	1732-2964	47	221
	Piemonte	1742-2501	37	587
	Trentino Alto Adige	1008-2579	58	850
	Valle d'Aosta	1806-3538	17	88
	Veneto	1299-2266	16	249
Apennines	Abruzzo	1300-1818	7	212
	Emilia Romagna	1307-1507	4	146
	Lazio	1788	1	11
	Marche	1940	1	5

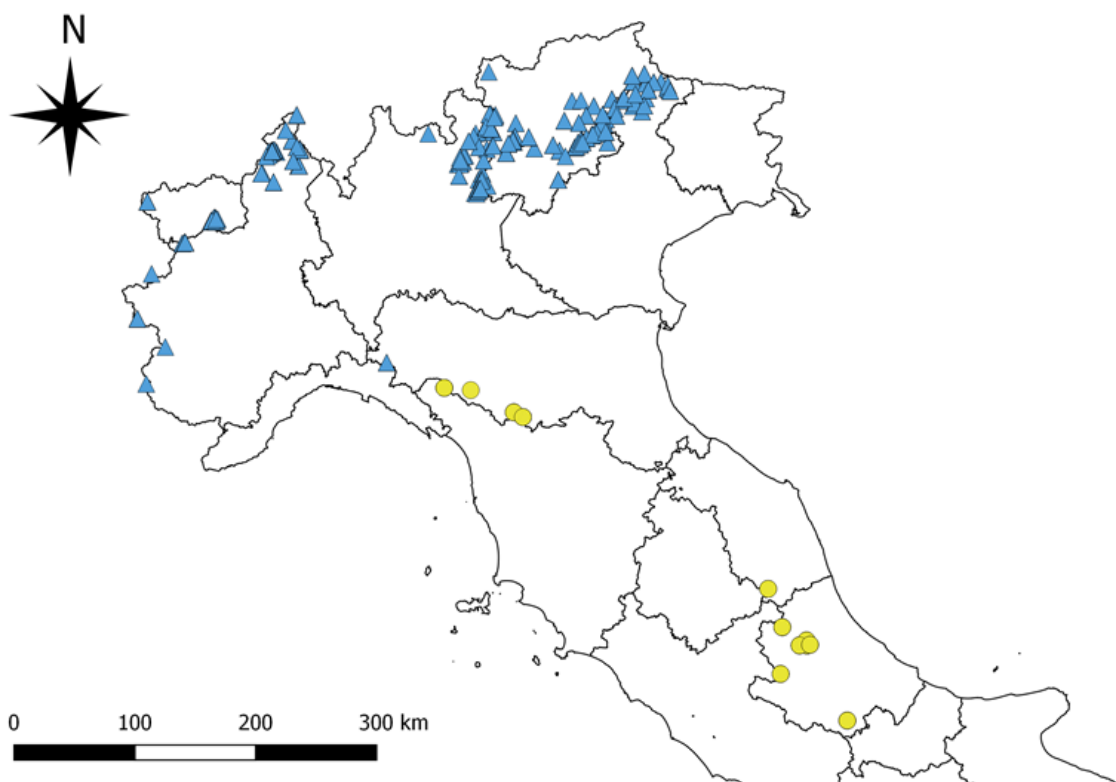


Figure 1. Location of the mountain lakes considered in the present work distributed in Northern and Central Italy. Δ Alpine lakes, \circ Apennine lakes.

Table 3. Full information linked to the data set with variables, definitions, units and type of storage.

Variables	Description	Units	Storage type
ID code	Unique identifier for the record within the data set		Integer
Kingdom	Full scientific name of the kingdom in which the taxon is currently classified (2016)		String
Phylum	Full scientific name of the phylum in which the taxon is currently classified (2016)		String
Class	Full scientific name of the class in which the taxon is currently classified (2016)		String
Superorder	Full scientific name of the superorder in which the taxon is currently classified (2016)		String
Order	Full scientific name of the order in which the taxon is currently classified (2016)		String
Family	Full scientific name of the family in which the taxon is currently classified (2016)		String
Subfamily	Full scientific name of the subfamily in which the taxon is currently classified (2016)		String
Tribe	Full scientific name of the tribe in which the taxon is currently classified (2016)		String
Accepted genus name	Full scientific name of the genus in which the taxon is currently classified (2016)		String
Accepted species epithet	Epithet of the species in which the taxon is currently classified (2016)		String
Accepted taxon name	Full binomial name of the species, according to its current classification (2016)		String
Author/s and date of 1st description	Authorship information and four-digit year of the first description of the accepted taxon name		String
Level of classification (updated)	Maximum level of biological classification by which the taxon is classified		String
Original cited genus	Full scientific name of the genus as provided in the original paper		String
Original cited species epithet	Epithet of the species as provided in the original paper		String
Original cited species name	Full binomial name of the species as provided in the original paper		String
Frequency data format	One or more data format in which the frequency of occurrence is provided in the original paper		String
Year of publication	Four-digit year of the paper providing original species record		Integer
Record reference	Full information on the scientific paper		String

Mountain range	providing original species record Major Italian mountain range in which the species was sampled		String
Administrative region	First-level administrative division to which the sampled lakes belong		String
Lake name	Name of the sampled lake		String
Alternative lake name	Second name of the sampled lake		String
Type of lake	Water-body type		String
Latitude N	Geographic latitude (in decimal degrees, using the spatial reference system given in geodetic Datum) of the geographic center of a location	Decimal degrees (projection EPSG:4326 WGS84)	Numeric
Longitude E	Geographic longitude (in decimal degrees, using the spatial reference system given in geodetic Datum) of the geographic center of a location	Decimal degrees (projection EPSG:4326 WGS84)	Numeric
Altitude	Explicit elevation above sea level of the sampled lake	meters	Numeric
Maximum depth	Maximum water depth of the sampled lake	meters	Numeric

Data set

Object name: Macroinvertebrates from Italian mountain lakes

Data set citation: Mountain lake Macroinvertebrates_2017

Character encoding: UTF-8

Format name: csv, comma-separated values

Format version: 1.0

Distribution (permanent link):
<http://www.ise.cnr.it/products/datasets>

Date of creation: 6 November 2017

Date of last revision: 24 November 2017

Date of publication: 8 November 2017

Update policy: LifeWatch policy rules

Language: English

License of use: if used by researchers, administrators, managers, teachers, amateurs, general public, and others, the access is free and the use is based upon request. Details are defined in the intellectual property information. The data set authors would appreciate users providing a link to the original data set, when possible, or when researchers use the data to cite the present paper and/or to consider the data set authors for co-authorship.

Metadata language: English

Metadata managers: Angela Boggero (a.boggero@ise.cnr.it)

Management details

Project title: A searching trip to the discovery of mountain lakes macroinvertebrates

Database managers: Angela Boggero

Temporal coverage: the present data set refers to more than a century of published works (1902-2016).

Record basis: Literature records.

Sampling methods: The data set was created by collating different data sets included in several published scientific or educational papers.

Funding grants: Data of the original publications screened were obtained within the framework of several European and national projects.

Geographic coverage

Study area: lakes are distributed along the Italian peninsula (Fig. 1) covering mostly the Alps (6 administrative regions) and partly (4 administrative regions) the Apennines. In the present paper, the definition adopted for mountain lake is: surface standing waters showing areas greater than 1 ha (0.01 km²) and maximum depths, at mean water level, greater than 1 m (British Standards Institution 2011), placed in proximity of or above the tree line. The latter is a non-linear wavy line between the subalpine and the alpine areas, drawn on the basis of tree-growth limiting factors (Körner 1998).

Bounding box:

- Alps: min Longitude: 6.79 - max Longitude: 12.49, min Latitude: 44.41 - max Latitude: 46.75, min Altitude: 1008 - max Altitude: 3538

- Apennines: min Longitude 10.00 - max Longitude: 13.98, min Latitude: 41.81 - max Latitude: 44.40, min Altitude: 1300 - max Altitude: 1940

Sampling design: The data set was created including all the available records and publications on the considered lakes, to the best of our knowledge.

Habitat type: Natural lakes (i.e. lakes without anthropic infrastructures), reservoirs (i.e. dams), and artificially extended lakes (i.e. lakes partially modified by anthropic infrastructures) were considered.

Biogeographic region: Alpine, Continental and Mediterranean (EEA 2002)

Country: Italy

Quality control for geographic data: Quality control was performed using:

i) Google maps identification of lakes, altitude, latitude and longitude coordinates provided by the scientific papers and transformed and standardized to WGS84 DD;

ii) the lake cadaster of the regions or provinces, when available:

•http://109.205.109.121:2725/pmapper/database_cor_pi_idrici/laghi_parametri_list.php;

•<http://www.bagolino.net/territorio.htm>;

•<http://trentinexp.it/home>;

•http://www.comune.brescia.it/servizi/arteculturaeturismo/museoscienze/Documents/1987_24_75-76_Berruti.pdf

iii) Geographic coordinates format, coordinates within country/provincial boundaries, absence of ASCII anomalous characters in the data set were additionally controlled.

Literature search

General description: A first search for papers was conducted in the archives and online library of the CNR-ISE. Other scientific papers were searched at academic or museum libraries. Lastly, internet (Scholar) provided information on bibliography, titles, and sources of the recent authors.

Literature search methods: A total of 76 published papers were obtained for the period 1902-2016, comprising grey literature (i.e. materials and research produced by organizations outside of the traditional commercial or academic publishing and distribution channels), educational, and Italian and international papers.

Literature list: The following papers were obtained as a result of the search: Ansaloni et al. (2015), Ansaloni et al. (2016), Baldi (1941), Barbato (1984), Bazzanti et al. (1988), Bichteler et al. (1998), Blesio (1985), Boggero & Nocentini (1994), Boggero & Lencioni (2006), Boggero et al. (1996), Boggero et al. (2012), Boggero et al. (2005), Boni et

al. (1983), Buffa (1902), Cantonati et al. (2014), Cappelletti et al. (2004), Casellato & Zanfei (1988), Cianficconi & Moretti (1992), Dal Cortivo et al. (2009), Decet (2007a), Decet (2007b), Decet (2007c), Decet & Fossa (2001), Dell'Uomo et al. (1980), Di Giorgio & Zuppa (1996), Di Sabatino et al. (2004), Dumnicka & Boggero (2007), Evangelista (2009), Facchini & Badino (1998), Ferrarese (2002), Ferrarese & Lencioni (2003), Ferrari & Bellavere (1976), Filippi et al. (2005a), Filippi et al. (2005b), Fjellheim et al. (2009), Forasacco (1998-1999), Franceschini & Lencioni (2002), Gambetta (1932), Garibaldi et al. (1987), Gianotti & Di Giovanni (1971), Guilizzoni et al. (1996), Heiri et al. (2005), Iannilli et al. (2004), Lami et al. (2011), Largaiolli (1907), Lazzara et al. (2006), Lencioni & Lazzara (2004), Marchesoni & Moretti (1954), Marchetto et al. (2004), Marcuzzi (1956), Marcuzzi (1988), Mascagni & Terzani (1983), Mastrantuono (1987), Miccoli et al. (2005), Monti (1936), Morabito et al. (2007-2008), Moretti (1942), Moretti & Corallini Sorcetti (1991), Mosello et al. (1993), Nardi (2005), Nardi (2014), Nardi & Castagnolo (2009), Naviglio (1984), Novelli et al. (1997), Osella & Pannunzio (2013), Paganelli (1992), Rossaro et al. (2012), Ruffo (1951), Ruggiero et al. (2004), Ruggiero et al. (2001), Seminara & Bazzanti (1988), Sommani (1952), Terzani (1977), Terzani & Mascagni (2005), Tonolli (1949), Tortonese & Rossi (1954).

Quality control for literature data: The authors of the present publication do not take responsibility for the taxonomic accuracy and reliability of data provided by the scientific publication listed in the data set. The data set is intended as a taxonomic collection and as an update of species names listed in the references. The published data were checked for spelling errors, synonymies, nomenclatorial consistency, and updated for their taxonomy, to ensure data standardization.

Taxonomic coverage

General description: The data set includes records of aquatic macroinvertebrates. The list of taxa contains information updated until December 2016 following the Fauna Europaea rules. The checklist presents taxa arranged according to the Fauna Europaea classification (2004), where subgenera and species are listed alphabetically within each genus (de Jong et al. 2014). Nomenclature includes terms such as “sp” (abbreviation of species) and “indet” (abbreviation of indetermined), when

necessary, without a dot to avoid problems in database searches.

Taxonomic ranks: macroinvertebrates are a heterogeneous group of aquatic organisms visible to the naked eye without employing optical instruments, living in contact with sediments on the bottom of lotic and lentic ecosystems. Macroinvertebrates include immature and adult stages of many different types of invertebrates, such as aquatic insects, crustaceans, mollusks, annelids, flatworms, and cnidarians.

Taxonomic methods: These methods include the revision of names, synonyms, the delimitation of genera and higher taxa, following Fauna Europaea (<https://fauna-eu.org/>) as a reference.

Taxon specialist: The first author is responsible for the data management and for the taxonomic update of the entire set of species included in the data set. The authors are not responsible for the identifications carried out by other researchers.

Quality control for taxonomic data: Record validation and cleaning using Fauna Europaea were

based on several steps and divided into: a) data check for spelling errors, b) data standardization (check of nomenclatural changes or synonyms), and c) data cleaning and validation for taxonomic reliability and taxonomic consistency.

CONCLUSIONS

Despite the amount of data on Italian macroinvertebrates and the increased interest in the study of this group, slow progresses has been undertaken in defining and refining the taxonomy and systematics of this extensive and widespread group. The checklist presented herein aims to give an updated account of taxonomically accepted species names recorded in the lakes of the mountain Italian regions by different researchers and naturalists in the last century, and to provide information on the geographic distribution of these species by mountain range and administrative region.

AUTHORS CONTRIBUTION

Angela Boggero: responsible and coordinator for activities on macroinvertebrates at CNR-ISE, planned the work, contacts with data providers.

Laura Garzoli: co-structured the data set, contributed in manuscript preparation.

Gianfranco Varini: collected, controlled, and standardised morphological and geographic lake data.

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