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Definition of hydrologic regimes in regulated rivers for aquatic biodiversity conservation

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Abstract

Negative ecological effects of water withdrawal activities from lotic systems have led to the need for the restoration of naturally shaped flow schemes. As a first step in this direction, individuation of sustainable minimum flow volumes can limit extreme alteration of ecosystem structure and functionality. The definition of such minimum flow values, to be released downstream each water diversion structure, must follow the understanding and the quantification of ecological alteration related to flow reduction.

This thesis focuses on the study of instream ecological effects of water withdrawal from lowland rivers (Ticino and Adda rivers), with the purpose to define adequate indicators for the identification of ecological effects of hydrological alteration. The application of such indicators should be useful for the definition of environmentally sustainable minimum flow schemes.

For this purpose, national protocols for the study of biological communities were applied and critically analyzed. These monitoring criteria and tools appeared inadequate for addressing the hydrological assessment as postulated in this work and for the studied geographical context.

Alternative sampling and analysing methods are proposed, following two different directions: (1) a different approach in the use of a common and well known structural indicator (macroinvertebrate fauna) and (2) the integration of such structural descriptors with a functional approach that considers the river quality through ecosystem methabolism measures.

Although their widespread use, connected to simple field and laboratory application, macroinvertebrates appeared to be an inadequate tool for hydrological alteration monitoring. However, interesting considerations about relationship between community density and richness and environmental disturbance could be made.

Presented data about physico-chemical parameters, collected through the open-channel method, show an influence of flow on ecosystem functional processes, mainly related to influence on aquatic vegetation. Collected data were useful to define an easy method to assess general response of the ecosystem to hydrological modifications, which future application could lead to interesting results and to an alternative approach for the application of WFD (Dir. 2000/60/EC) requirements.

Contents

1 Introduction

1.1 General introduction

Water strategical importance for human life and societies development has historically lead to intense urbanization along main watercourses and to heavy water resource exploitation, through the construction of numerous catchment structures along them. Water withdrawal, nowadays mainly related to agriculture and hydropower energy production, often concerns high amounts of river flows, causing strong instream flow regime alteration in terms of volume and timing pattern of flow.

Despite the great economical value of water withdrawal, both water abstraction and the catchment structures themselves have carried many negative environmental consequences in fluvial systems which, in turns, lead to economic costs for the local communities.

First of all there are direct hydrological effects, such as alteration of seasonal flow pattern and mean annual flow reduction. Such alterations concern all different aspects of hydrologic regimes: magnitude, frequency, timing, duration and predictability of different flows (Poff, 1997).

Magilligan & Nislow (2005) found that presence of dams generally causes downstream diminished entity and duration of maximum flows, changed timing and consequently reduced predictability of short-time maximum and minimum flows and increased number of hydrograph reversals. Presence of diversion structures different than dams, such as catchments for canals, similarly reduces mean annual flow, but shows less short period variations, with a consequently minor effect on number of flow value reversals.

Indeed, shape of seasonal trend alteration changes with water use: agricultural water needs are more important during spring and summer than in autumn and winter, while this is not true for hydropower production and industrial uses. Hydropower uses can show mainly short time fluctuations, generating hydropeaking phenomena, especially in mountain areas (Cushman, 1985).

These direct hydrological effects of water withdrawals can cause secondary effects on stream morphology, both at local and watercourse scale. Hydraulic characteristics such as flow velocity and turbulence can indeed act on solid transport, sedimentation and resuspension, shaping stream bed morphology. Presence of dams, in addition, can reduce the downstream loads of fine materials. Such alterations of depositional characteristics by dams can lead to homogenization of stream bed substrate, with a consequent trivialization of inhabitant communities (Van Steeter & Pitlick, 1998; Pitlick & Van Steeter, 1998; Hadley & Emmett, 1998; Ligon *et al.*, 1995; Baker *et al.*, 2011). Local morphology alterations can lead to a general loss of habitats, in terms of spatial complexity, connectivity and dynamism (Elosegi *et al.*, 2010).

Interruption of longitudinal connectivity by wires can locally endanger fish species which need to move to complete their lifecycle and prevent recolonization of perturbed areas (Elosegi et *al.*, 2010). Loss of lateral connectivity, caused by flow reduction, acts similarly as an ecological barrier for animal and plant species between different river branches and between the main channel and lateral environments of floodplain.

Changes in timing and predictability of natural flows can result in temporary absence of particular habitats which can be important for species in delicate moments of their lifecycles, like fish spawning and fry growth. Changes in frequencies of natural flows, with increasing in number of hydrograph reversals, disrupt natural dynamism of instream hydro-morphology and could result in too strong environmental instability for biota, which could decrease biodiversity (Gore *et al.*, 1989).

All of these effects actually represent changes and reduction in habitats availability for riverine communities. Concerning this, we must remember that loss and fragmentation of habitats are among the main causes of trivialization of biotic communities and biodiversity reduction, as revealed by many studies in fluvial ecology (e.g. Dunham *et al.*, 1997; Ward, 1998; Fagan, 2002), as well as in other study fields (e.g. Klein, 1989; Vos & Chardon, 1998; Sala *et al.*, 2000; Tilman *et al.*, 2001).

Therefore, water use management schemes which restore natural dynamic could enhance biodiversity. Many authors emphasized the importance of the maintenance of natural flow regime for river ecology restoration (Poff *et* al., 1997; Petts, 1996; Richter *et* al., 1997; Chang *et* al., 2011). Nevertheless, in many strongly gauged systems, this appears not to be a simple managing solution, since it could require strong reduction and changing in water use. Where natural flow maintenance is difficultly applicable, individualization of minimum flow values has still great importance and nowadays its implementation in river management in Italy has just begun (even if it was introduced in Italian law in 1989 - L.183/89 -, its real application begun nearly 20 years afterwards).

Yet, minimum flow does represent only one aspect of the numerous components of a hydrologic regime. Other important aspects are: mean annual and monthly discharge, magnitude, timing and frequency of extreme discharges (Bragg *et al.*, 2005). Given the importance of flow variability and maintenance of these flow features, defined minimum flow values cannot be considered as a resolving solution to the problems connected with water diversion. Their application should limit ecological negative effects of water use during low flow periods, being a limit for overabstraction. For environmental conservation purpose, the presence into streambeds of minimum flows should hence not be continuous along the hydrological years, instead it should represent an extreme condition limited in time.

Definition of this “extreme condition” can be made through different approaches, whose choice and use are anything but easy and should preferably take into account local river system characteristics. It is also fundamental to have a good knowledge of low flow effects on hydro-morphology, biota and ecological functioning of stream ecosystems.

In the following chapter common methods for the definition of minimum flows are briefly commented.

1.2 Literature background

In last decades, since the importance of maintenance of minimum flows into streambeds was recognised, many different methods for their definition were proposed and used. Jowett (1997) and, most recently, Bragg *et* al. (2005) divided the different approaches into three types: historic flow methods, hydraulic methods and habitat methods.

In historic flow methods minimum flow values are calculated on the basis of natural flow regime characteristics, with many different approaches (e.g. Tennant, 1976; Jowett, 1997; Snelder *et al.*, 1998).

Hydraulic methods, instead, consider hydraulic characteristics and their changes with different flows.

Since the first two categories are based solely on the use of hydrological and hydraulic parameters, they define calculated minimum values without specific linkage with ecological effects. They appear hence to be affected by some degree of arbitrariety in the choice of acceptable values. Nonetheless, their simplicity, particularly for Montana method (Tennant, 1976), has made their use widespread. For example, the assumption that minimum flows should not undergo 10% mean annual natural flow was introduced in many Italian regions official approaches (see Capter 1.3).

Habitat methods, such as PHABSIM (Physical HAbitat Simulation, and related Instream Flow Incremental Methodology, Stalnaker *et al.*, 1995; Bovee *et al.*, 1998), take a step forward, linking hydro-morphological data to biological needs of target fish species, studying habitat suitability with different flows. Two main criticisable points for this kind of methods are the absence of fit with the European Water Framework Directive (WFD, Dir.2000/60/EC) objectives, since they are not based on the comparison between altered and reference conditions and, once more, the arbitrariety in the choice of target species, which can lead to very different results. Moreover, preference curves are not available for many species till now.

Habitat methods need an opening to new biological targets, which is strictly connected to an increase in knowledge about species instream flow preferences. This effort, particularly in the direction of macroinvertebrate fauna, was already begun by Gore & Judy (1981), but the need to extend information about many geographical contexts remains.

In using methods based on hydrological parameters, instead, there is the need to verify that defined flow rates are sufficient for environmental protection, in terms of ecosystem structure and functionality. Fluvial biological communities are sensitive to hydrology (Bragg *et al.*, 2005) and communities structure in many cases was used to detect hydrological alteration. For example, benthic macroinvertebrates community structure was at the basis of LIFE index (Lotic Invertebrate index for Flow Evaluation, Extence *et al.*, 1999) and CEFI index (Canadian Ecological Flow Index, Armanini *et*

al., 2011). Many attempts were made to use also other biological communities (mainly macrophytes) to detect perturbation connected with flow alteration (e.g. Biggs, 1996; Clarke & Wharton, 1998), although macroinvertebrates remain the simplest and best known indicators for lotic environments.
As just presented, many attempts were made to identify minimum flow schemes based on biological communities needs or on assumptions about hydro-morphological effects of water abstraction. Surprisingly few attempts were made to connect minimum flows to ecosystems functionality, that represents the last step of a series of cascade effects of water withdrawal on fluvial environment and the final protection target of the WFD.

1.3 Study aims and project structure

Italian laws in the field of minimum flow and catchment management are different region by region, since this is a regional task. Each region indeed developed different criteria to define minimum flows, but they are generally based on hydrologic methods, by using formulas which commonly lead to values equal or lower than 10% of mean annual natural flow (e.g. Regione Emilia Romagna, 2005; Regione Lombardia, 2006; Regione Piemonte, 2007).
Given this, it appears of great importance to be able to assess effects of the applied criteria and flow values on biota and ecosystem functions. Many regions provide for the possibility to verify ecological effects of minimum flows and to define them taking into account local characteristics of river systems. In Lombardy, where this study has been developed, minimum flow values can be defined either by the application of a formula (1) defined by the Authority of Po River Basin (Autorità di Bacino del Fiume Po, 2002), were *k* is chosen as 10%, or through the application of different experimental minimum flows, whose acceptability must be evaluated in a three year period of ecological monitoring (Regione Lombardia, 2006; D.d.g. 9001/2008).
Formula of the Authority of Po River Basin for the calculation of minimum flow is:

$$Q_{DMV} = k*q_{MEDA}*S*M*Z*A*T \qquad (1)$$

where Q_{DMV} is minimum flow value (l/s); k is the experimental parameter that indicates the percentage of mean annual natural flow; q_{MEDA} mean annual specific flow (l/s/km^2); S is the area of the waterbasin; M is a morphological parameter; Z is a parameter that concerns the degree of protection of the area; A is a parameter that concerns hyporheic accrual; T is a temporal modulation parameter. At the moment the coefficients M, Z and A has not yet been well defined.

The present study developed along with two hydraulic experimentations, in Ticino and Adda rivers (Consorzio del Ticino, 2008; Consorzio dell'Adda, 2009), which involve many different entities to confront each other and cooperate; these include Università degli Studi dell'Insubria, which acts as a scientific reference, GRAIA S.r.l., which conducted the ecological monitoring and Consorzio del Ticino and Consorzio dell'Adda, which financed the experimentations.

Focusing on two lowland Italian rivers (Ticino and Adda), the principal objectives of this study were (1) to define the best ecological indicators for evaluating the effects of flow alteration and to apply them to measure experimental minimum flow effects in the studied areas; (2) to define sustainable flow timing schemes, with special attention to minimum flow releases, in order to reduce hydrological regime alteration effects upon ecosystem structure; (3) to provide basic indications for moving from a biological structural approach (as stated by the national normative) towards an approach focusing of the fluvial processes (as stated by the WFD quality objectives).

1.1.1 Definition of indicators of hydrologic alterations

To achieve these goals, two different ways were followed: a structural approach and a functional approach.
The research for indicators was made keeping always in mind that simple and economical measure schemes and easily interpretable outputs are fundamental characteristics of a good indicator (Norris & Hawkins, 2000).

The structural approach

The structural approach started from the screening of the currently applied methods, provided by the Italian law (D.M. 260/2010) in response to statements of the Water Framework Directive. This directive states that watercourses monitoring should take into account the analysis of biological communities (benthic diatoms, benthic macroinvertebrates, macrophytes and fishes), for which the monitored condition must be compared with specific reference conditions to get a measure of the level of alteration for the studied ecosystem. The whole ecological status of a river should than be defined (with a precautionary approach) as the worst among the levels calculated for each of the studied indicators.
Unfortunately, results of monitoring programmes based on this scheme actually give no indication of the specific cause of alteration and on best management choices to fulfil quality objectives (generally of GES – Good Ecological Status within 2015, as stated by the WFD). It is so necessary to develop new indicators to answer to management problems related to specific alterations, such as the hydrologic alteration.
Although this monitoring system has as its main purpose only the general classification of the watercourses status, the indicators considered represent important biological components of lotic systems and therefore WFD requirements have stimulated the creation of new analytical methodologies for riverine communities study, e.g. the introduction of a quantitative method for benthic invertebrates study (APAT, 2007). In the present study some of these methodologies are used and adapted to get from traditional bioindicators specific information about hydrological effects. In particular, among the indicators provided for the WFD, benthic macroinvertebrates were selected,

since a huge amount of literature is disposable about their connection with hydrologic and hydraulic parameters (e.g. Gore & Judy, 1981; Extence et al., 1999; Cortes et al., 2002; Jowett, 2003; Brooks et al., 2005; Monk et al., 2006; Armanini et al., 2011). Being relatively simple to be sampled and analyzed, they also appear to be an easy tool to be applied in common monitoring schemes.

The functional approach

The functional approach represents a top-down scheme for monitoring the status of a river; it is indeed an attempt to develop an easily applicable method to get a response of the whole ecosystem functional integrity. The importance of the use of indicators of ecosystem functionality to complete information coming from structural indicators was already stressed by Young *et al.* 2008.

Indeed, thinking about ecosystem functionality as the combination of all of the biotic and abiotic processes acting into the ecosystem, the possibility to measure functionality status corresponds to a possibility to directly measure the ecosystem health. An eventual unexpected change in functionality values would indicate a disequilibrium and would therefore require for specific monitoring in order to identify the origin of the problem.

In order to follow this approach, a river reach was studied being considered as a black-box model, in which parameters associated with ecosystem metabolism, such as dissolved oxygen and temperature, are measured on the start and at the end of the river reach. The model, generally named as *open-channel method*, was firstly purposed by Odum (1956), who used it to calculate production/respiration ratios (P/R), and than used and refined by many authors (e.g. Chapra & DiToro, 1991; McCutchan *et al.*, 2002; Ortiz-Zayas *et al*., 2005). However, at my knowledge, this method was never applied to get information about the ecological effects of low flows in rivers.

In the present study the same scheme was applied in different flow and seasonal conditions, on reaches characterized by different morphology (i.e. with and without the presence of a riparian wetted environment in connection with the principal channel) and was also used to get further information on ecosystem status.

In the present study, the application of the open-channel method to a river reach characterised by the presence of a lateral environment goes in the direction of an application of the flood-pulse concept (FPC, Junk *et al*., 1989), considering the main channel and the floodplain as a whole entity. Connection with floodplain has indeed particular importance in lowland rivers, where it acts as a main force in regulating nutrient and energy inputs and outputs, leaving at longitudinal transport a minority importance (Sedell *et al*., 1989).

River functionality is indeed determined not only by internal biological processes, but also by those acting in surrounding areas. Nevertheless, monitoring of the whole system appears to be difficult, while environmental management needs rapid and synthetic indications about the status of ecosystems.

This approach appears particularly interesting since WFD asks for the achievement of a good ecological status for European watercourses. Ecological status is linked to ecosystem functionality and can difficultly be assessed through structural indicators, unless changes in their characteristics are recognized to be linked with any change in functionality. This approach indeed represent a complementary method to fulfil WFD requests.

1.1.2 Individualization of minimum flow values and "environmental sustainable flow schemes"

Results from applied indicators (both from the structural and the functional approaches) are used to write a path to be followed for the definition of minimum flow values to be applied in the studied rivers.

Given a good knowledge of the river system, this procedure could possibly be applied also to similar watercourses.

2 Study areas

Data collected for the present study refer to two lowland rivers, flowing in northern Italy: Adda and Ticino. Both of them rise in Alps, pass trough prealpine lakes and finally flow into Po (Figure 1). For the present study only the second part of the watercourses, after lakes, is taken into account.

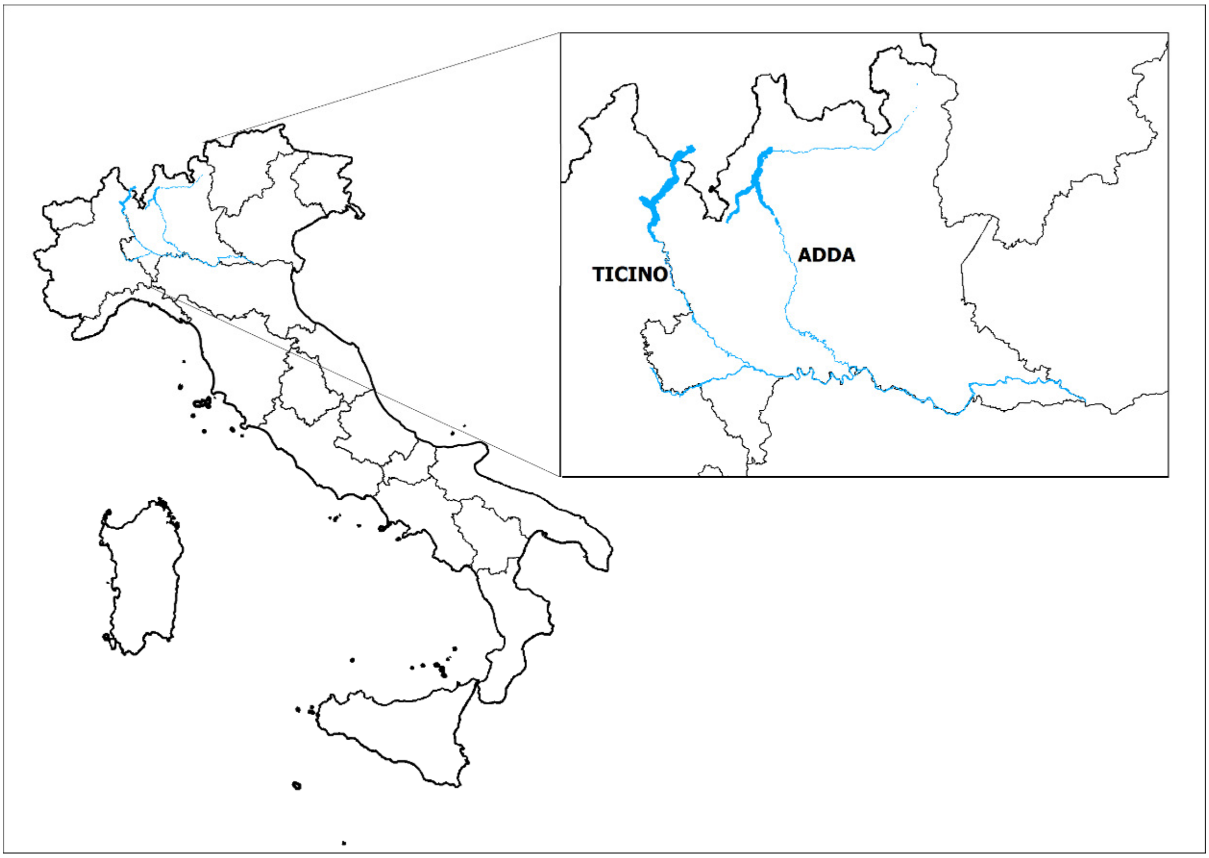


Figure 1 Position of Adda river and Ticino river into Italy and Lombardy.

While Adda flows entirely in Lombardy region, Ticino identifies, for a long reach, the boundary between Lombardy region (east) and Piedmont region (west). Since in Italy water management is partly a regional task, for minimum flow management in Ticino river Lombardy and Piedmont institutions work together.

Both river reaches are characterized by strong water withdrawal.

2.1 Adda river

Adda river rises in Rhaetian Alps in Alpiselllla valley (Valdidentro village), passes trough lake Lario and flows into Po river in Castiglione Bocca d'Adda (Figure 3).

It is 313 km long, being the fourth Italian river for length, and has a 7979 km^2 waterbasin (Regione Lombardia, 2006).

Mean annual flow after the lake exit is 160 m^3/s (calculated on a 50-years period; Regione Lombardia, 2006).

For the present study, the reach between lake exit and Lodi city is taken into account. Into this reach thirteen big water diversion structures (with a grant major than 1000 l/s for irrigation purpose and 3000 kW mean annual power for hydropower use; R.R. 2/2006, R.D. 1775/1933) are present. Twelve of these take part to the experimentation programme (all but S. Anna plant, Table 1).

Table 1 Water diversion structures located on Adda river along the studied reach. All with the exception of S.Anna power station take part in the minimum flow experimentation. Data about flow grants come from Consorzio dell'Adda. I = irrigation; H = hydropower production and industrial uses.

ID	Structure name	Corporation	Village	Coordinates	Principal use	Grant (m^3/s) Oct.–Mar.	Grant (m^3/s) Apr.–Sep.
1	Pasinetti canal	Consorzio Media Pianura Bergamasca	Brivio (LC)	45°41'52.61'' N 9°27'24.37'' E	I	0	10
2	Esterle power station	Edison S.p.A.	Robbiate (LC)	45°41'20.61'' N 9°27'05.77'' E	H	80	80
3	Bertini power station	Edison S.p.A.	Paderno d'Adda (LC)	45°40'50.36'' N 9°27'22.90'' E	H	50	50
4	Taccani power station	ENEL Green Power S.p.A.	Trezzo sull'Adda (MI)	45°36'53.52'' N 9°91'14.62'' E	H	180	180
5	Concesa power station	ITALGEN S.p.A.	Trezzo sull'Adda (MI)	45°36'14.54'' N 9°31'44.41'' E	H	125	125
	Martesana canal	Consorzio Bonifica Est Ticino Villoresi			I	30	32
6	S.Anna power station	ADDA ENERGI S.r.l.	Fara Gera d'Adda (BG)	45°33'57.60'' N 9°31'49.14'' E	H	65	65
	Vailata canal	Consorzio generale della Roggia Vailata			I	1.7	9.5
7	Rusca power station	AGRI S.p.A.	Cassano d'Adda (MI)	45°32'28.68'' N 9°31'40.06'' E	H	140	140
8	Retorto canal	Consorzio Canale Retorto	Cassano d'Adda (MI)	45°31'45.52'' N 9°32'01.72'' E	I	6.3	21
9	Muzza canal	Consorzio Bonifica Muzza Bassa Lodigiana	Cassano d'Adda (MI)	45°31'32.94'' N 9°31'42.97'' E	I	0	7.2
	Rivoltana canal	Consorzio Roggia Rivoltana			I	61	112
10	Vacchelli canal	Consorzio Irrigazioni Cremonesi	Merlino (LO)	45°25'24.81'' N 9°27'43.83'' E	I	15	38.5

Experimental minimum flow values applied in the diversion sections previously listed are temporally (monthly) modulated. Moreover a longitudinal modulation exist, with three different schemes, which are related to different water uses: reach A, mainly characterized by hydropower uses, has higher minimum flow values from April to September, to guarantee higher flows in downstream reach C, characterized by agricultural uses, which are indeed stronger in spring and summer; reach B has intermediate characteristics between the previous two (Table 2). Experimental minimum flow schemes are represented in Figure 2.

Table 2 Minimum flow values to be released by each water catchment taking part of the experimentation. In section 6 S. Anna power plant releases continuously 10% minimum flow, since it does not take part to the programme. In section 4 and 8 only a 5% minimum flow is continuously released because of the brevity and morphological particularity of the reaches between sections 4 and 5, and 8 and 9.

Reach	ID	Minimum flow to be released	January	February	March	April	May	June	July	August	September	October	November	December	Annual mean
A	1	%	5,5	5,5	5,5	7	9	10	8	6	6	6	6	6	6,7
		m^3/s	9.1	9.1	9.1	11.6	14.9	16.5	13.2	9.9	9.9	9.9	9.9	9.9	11.1
	2	%	5,5	5,5	5,5	7	9	10	8	6	6	6	6	6	6,7
		m^3/s	9.1	9.1	9.1	11.6	14.9	16.5	13.2	9.9	9.9	9.9	9.9	9.9	11.1
	3	%	5,5	5,5	5,5	7	9	10	8	6	6	6	6	6	6,7
		m^3/s	9.1	9.1	9.1	11.6	14.9	16.6	13.3	9.9	9.9	9.9	9.9	9.9	11.1
	4	%	5	5	5	5	5	5	5	5	5	5	5	5	5
		m^3/s	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
	5	%	5,5	5,5	5,5	7	9	10	8	6	6	6	6	6	6,7
		m^3/s	9.2	9.2	9.2	11.7	15.1	16.7	13.4	10.0	10.0	10.0	10.0	10.0	11.2
B	6	%	7	7	7	6	5	5	5	5	6	6	6	7	6,5
		m^3/s	14.2	14.2	14.2	12.2	10.2	10.2	10.2	10.2	12.2	12.2	12.2	14.2	13.3
	7	%	7	7	7	6	5	5	5	5	6	6	6	7	6,5
		m^3/s	14.3	14.3	14.3	12.2	10.2	10.2	10.2	10.2	12.2	12.2	12.2	14.3	13.3
	8	%	5	5	5	5	5	5	5	5	5	5	5	5	5
		m^3/s	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
	9	%	7	7	7	6	5	5	5	5	6	6	6	7	6,5
		m^3/s	14.8	14.8	14.8	12.7	10.6	10.6	10.6	10.6	12.7	12.7	12.7	14.8	13.8
C	10	%	10	10	10	6	5	5	5	5	6	10	10	10	7,7
		m^3/s	22.1	22.1	22.1	13.2	11.0	11.0	11.0	11.0	13.2	22.1	22.1	22.1	17.0

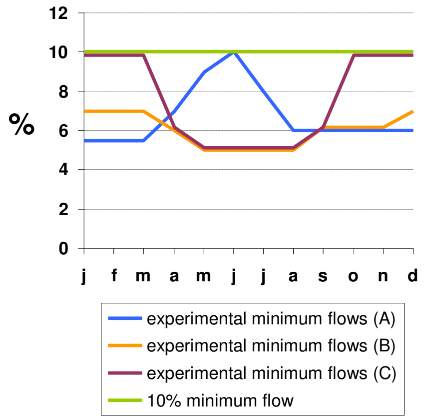


Figure 2 Experimental versus standard 10% minimum flows in Adda river for river reaches A, B and C.

The big water diversion structures and the seven sampling sites identified along the watercourse are represented in Figure 3.

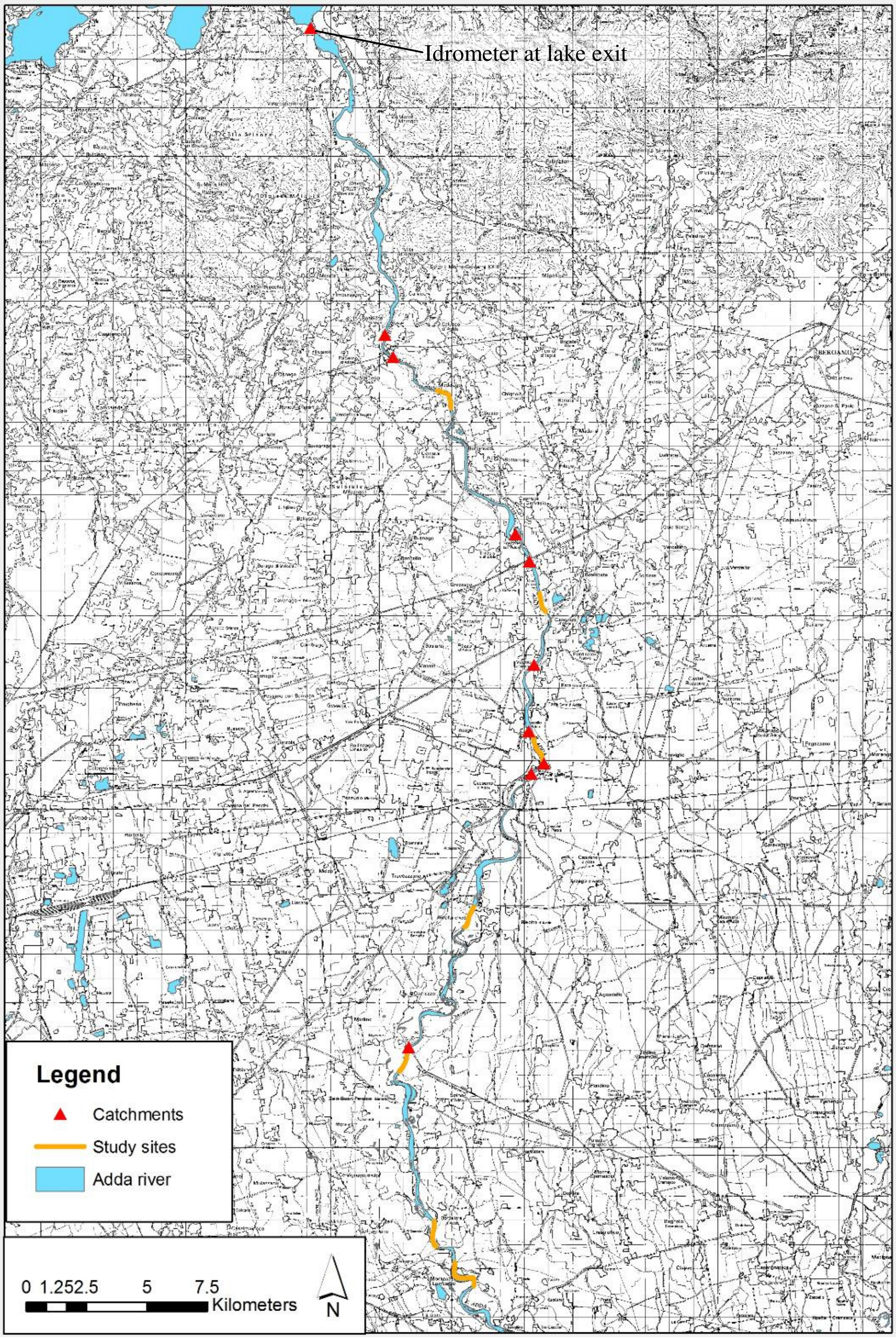


Figure 3 Reach of Adda river of interest for the present study, with water withdrawals and study sites.

The studied reach is completely included into two regional parks: Parco Adda Nord (between the lake and Rivolta d'Adda) and Parco Adda Sud (between Rivolta d'Adda and the mouth).

ADS1

Site here hence called ADS1 is located in Suisio (BG) (45°39'31.40'' N, 9°29'15.74'' E), 4.1 km downstream Paderno dam. Upstream this site, water is caught by Edison S.p.A., leaving a mean annual flow of 39 m^3/s (Consorzio dell'Adda, 2009).

ADS2

Site ADS2 is located in Vaprio d'Adda (MI) (45°35'15.24'' N, 9°32'05.28'' E), 1.8 km downstream Concesa dam. Upstream this site, water is caught by ITALGEN S.p.A. and Consorzio Bonifica est Ticino Villoresi, leaving a mean annual flow of 32 m^3/s (Consorzio dell'Adda, 2009).

ADS3

Site named ADS3 is located in Fara Gera d'Adda (BG) (45°32'18.46'' N, 9°31'47.12'' E), 0.4 km downstream Rusca dam. Upstream this site, water is caught by AGRI S.p.A, leaving a mean annual flow of 35 m^3/s (Consorzio dell'Adda, 2009).

ADS4

Site here hence called ADS4 is located in Rivolta d'Adda (CR) (45°28'26.48'' N, 9°29ì49.28'' E), 7.8 km downstream Muzza canal catchment. Upstream this site, water is caught by Consorzio Bonifica Muzza Bassa Lodgiana, leaving a mean annual flow of 78 m^3/s (Consorzio dell'Adda, 2009).

ADS5

Site ADS5 is located in Comazzo (LO) (45°25'12.99'' N, 9°27'44.11'' E), 0.5 km downstream Vacchelli canal catchment. Upstream this site, water is caught by Consorzio Irrigazioni Cremonesi, leaving a mean annual flow of 64 m^3/s (Consorzio dell'Adda, 2009).

ADS6

Site named ADS6 is located in Boffalora d'Adda (LO) (45°21'10.98'' N, 9°28'30.17'' E), 9.5 km downstream Vacchelli canal catchment. This site was chosen as a further monitoring point for minimum flow released by Vacchelli canal catchment, being inserted in a Site of Community Importance (SIC IT 2090006 *Spiagge Fluviali di Boffalora*) and so of high natural interest.

ADS7

Site here hence called ADS7 is located in Montanaso Lombardo (LO) (45°20'08.61'' N, 9°29'26.00'' E), 11.7 km downstream Vacchelli canal catchment and 0.6 km downstream Belgiardino canal income (mean annual discharge 20 m^3/s). This site was chosen because of the presence of that canal, which is characterized by warm waters.

2.2 Ticino river

Ticino river rises from two different springs in Switzerland, in Pennine Alps nearby Novena pass (Ulrichen village) and San Gottardo pass (Airolo village); it passes trough lake Verbano and flows into Po river in Linarolo (Figure 5).

It is 248 km long and has a 8172 km^2 waterbasin (Lombardia, 2006).

Mean annual flow at the lake exit is 284 m^3/s (calculated on a 60-years period; Regione Lombardia, 2006), being the second river in Italy for mean annual flow.

For the present study, the reach between lake exit and Turbigo village is taken into account. Into this reach 6 big water diversion structures are present. All of these take part to the experimentation programme (Table 3).

Table 3 Water diversion structures present on Ticino river along the studied reach. Data about flow grants and their range of variation from winter to summer come from Regione Lombardia (2006). I = irrigation; H = hydropower production and industrial uses.

ID	Structure name	Corporation	Village	Coordinates	Principal use	Mean annual grant (m^3/s)
1	Regina Elena canal	Associazione Irrigazione Est Sesia	Varallo Pombia	45°41’08’’,73 N 8°38’20’’,53 E	I	28 (range 3 ~ 58)
	Villoresi canal (rising from Panperduto dam)	Consorzio Bonifica Est Ticino Villoresi	Somma Lombardo	45°40’18.09’’ N 8°40’55.53’’ E	I	31 (range 3 ~ 66)
	Industriale canal (rising from Panperduto dam)	ENEL Green Power S.p.A.			H	106.5
2	Clerici and Simonetta canals	Associazione Irrigazione Est Sesia	Varallo Pombia	45°39’32.60’’ N 8°40’39.19’’ E	I	1.26
	Molinara di Oleggio canal	Associazione Irrigazione Est Sesia			I	5 (range 2.7 ~ 5.8)
3	Langosco canal	Associazione Irrigazione Est Sesia	Cameri	45°32’13.40’’ N 8°42’53.94’’ E	I	20 (18 ~ 23)

Experimental minimum flow values applied on Ticino river are identical for all of the three different sections and follow a three parts scheme: 18 m^3/s for the first four months, 12 from May to August and 22 in the last four months of the year. This minimum flow scheme is represented in Figure 4.

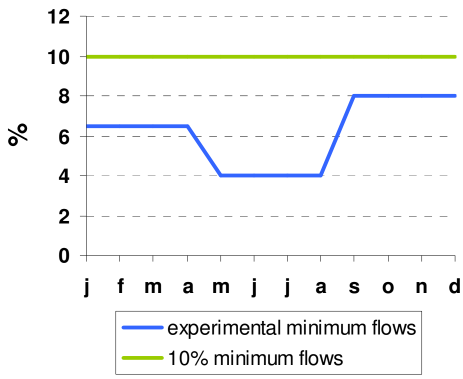


Figure 4 Experimental versus standard 10% minimum flows in Ticino river for river.

The big water diversion structures and the 5 sampling sites identified on the watercourse are represented in Figure 5.

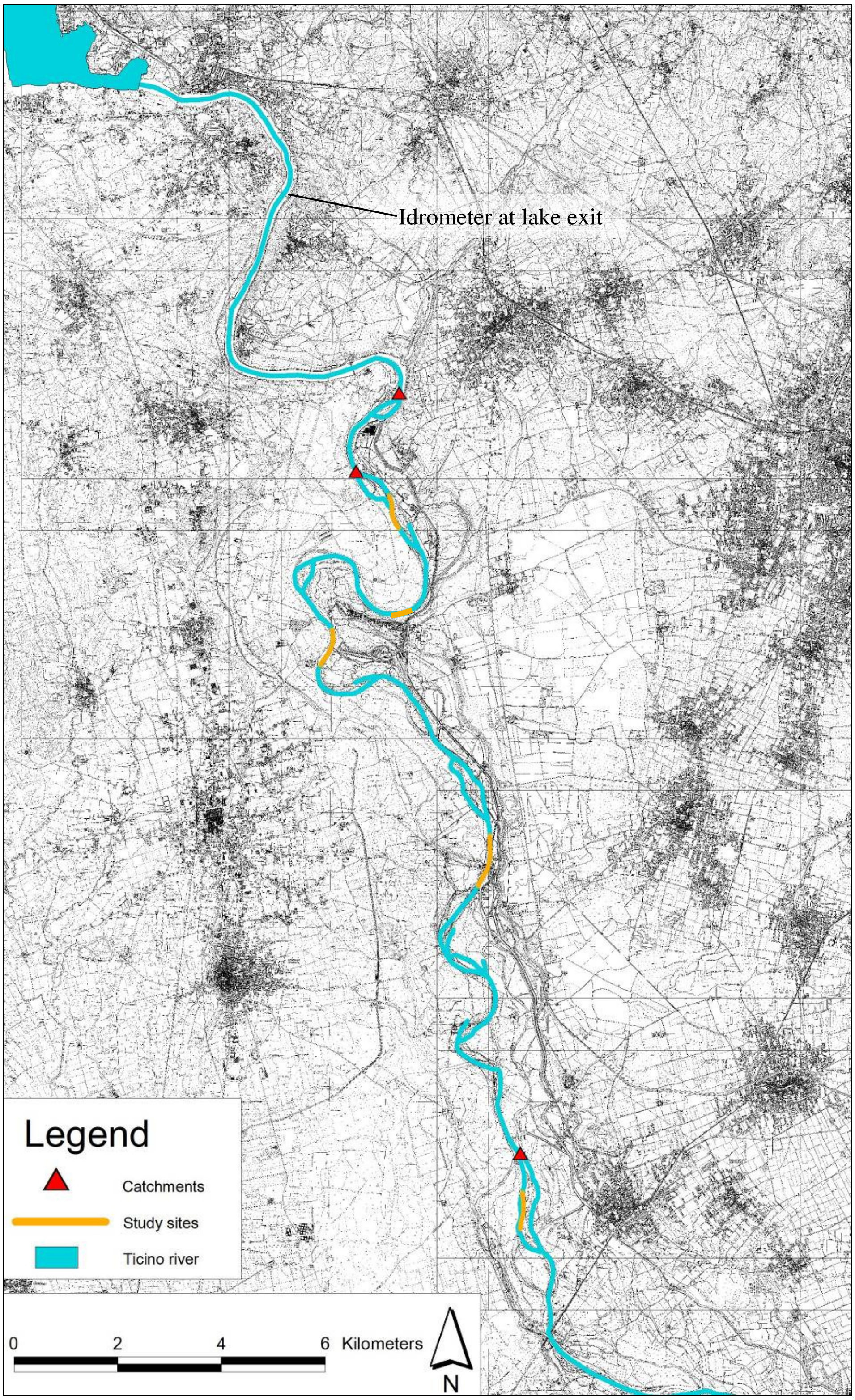


Figure 5 Reach of Ticino river of interest for the present study, with water withdrawals and study sites.

All the studied reach is included into two Regional Parks: Parco Lombardo della Valle del Ticino (on the east side) and Parco Piemontese della Valle del Ticino (on the west side).

TIC1

Site here hence called TIC1 is located in Somma Lombardo (VA) (45°39'05.81'' N, 8°41'03.99'' E), 2.8 km downstream Panperduto dam and 1.1 km downstream Clerici and Simonetta ditches catchment. Upstream this site, water is caught by different corporations (see Table 3), leaving a mean annual flow for the last 6 years of 95 m^3/s (data from Consorzio del Ticino).

For the purposes of the functionality study this site will be called *Maddalena*.

Mazzini

Site called *Mazzini* is located in Vizzola Ticino (VA) (45°37'55.88'' N, 8°40'53.77'' E), 5.4 km downstream Panperduto dam and 3.7 km downstream Clerici and Simonetta ditches catchment.

This site was used only for the aims of the functional approach.

TIC2

Site TIC2 is located in Vizzola Ticino (VA) (45°38'00.84'' N, 8°39'57.49'' E), 8.7 km downstream Panperduto dam and 7 km downstream Clerici and Simonetta ditches catchment. This site was chosen as a further monitoring point for minimum flow released at Panperduto dam.

For the purposes of the functionality study this site will be called *Porto*.

TIC3

Site named TIC3 is located in Lonate Pozzolo (VA) (45°35’47.70’’ N, 8°42’19.54’’ E) , 15 km downstream Panperduto dam and 13.3 km downstream Clerici and Simonetta ditches catchment. This site was chosen as a further monitoring point for minimum flow released at Panperduto dam.

TIC4

Site here hence called TIC4 is located in Turbigo (MI) (45°31’39.14’’ N, 8°43’04.90’’ E), 1.5 km downstream Langosco canal catchment. Upstream this site, water is caught by Associazione Irrigazione Est Sesia; unfortunately no precise flow data are available for this site, although flow is probably slightly inferior than that in other sites.

3 Materials and methods

3.1 Hydrological data collection

Data about daily flow values of the last seven-years period were provided by Consorzio dell'Adda and Consorzio del Ticino, which manage water level in lakes Verbano and Lario and the water diversions in the two water basins. Measures were taken by stable hydrometers. Measurement structures are located immediately downstream the lakes and at the main water diversion structures (Figure 3 and Figure 5).

Data about other river sections which could be of some interest for the present study were calculated as a difference between flows present in the river at lake exit and withdrawals. The consequent values are hence not to be intended as exact values, since exchanges with ground-water and little feeders were not considered in the computation. Nevertheless, these values can be considered precise enough for monitoring sites which are very close to upstream diversion structures (see Chapter 2).

For the present study flows at lake exits are considered as natural flows, in contrast to altered flows present downstream catchments, even if for Ticino and Adda rivers naturally-shaped flow schemes can difficultly be defined, because natural flow never occurs since water level in the upstanding lakes has been regulated, and it is also connected with river water management upstream the lakes themselves. In particular, Miorina weir on Ticino river regulates water outcoming lake Verbano and is active since 1942, and Olginate weir on Adda river regulates flows from lake Lario since 1944; while some water diversion structures are present along the watercourses since XII-XIII centuries (Naviglio Grande and Muzza canal).

Raw data can be found at lake management corporations official website (Lombardy lakes management corporations).

3.2 Biological data collection and analysis

1.1.3 Structural approach

Benthic macroinvertebrate communities

Sampling

Benthic macroinvertebrates were sampled from December 2009 till June 2012. Samples were collected in all the study sites presented in Chapter 2, both in Adda river and in Ticino river, with different sampling frequencies.

As a first step, national sampling protocol developed by Buffagni & Erba (2007, see also Buffagni et al., 2007; Erba et al., 2007; APAT, 2007) was applied. In compliance with WFD, this protocol provides for lowland river monitoring a quantitative sampling by using a surber sampler with a 500 μm mesh net and a quadrate base area of 0.05 m^2. Surber net is used to collect invertebrates along a river transect by placing it on the river substrate in 10 different points to collect a sample composed of 10 subsamples. The choice of the substrate typologies where the 10 replicates should be taken must be proportional to the percentage presence of the substrate typologies in the studied river reach. For each replicate, invertebrates are removed from the substrate using hands and brushes, to a depth into the substrate of approximately 15 cm.

Collected invertebrates are then sorted from other collected material, determined at family level and absolute abundances (number of individuals / 0.5 m^2) of all the found families are determined (Figure 6).

For the present study sorting and determining phases were conducted in laboratory and individuals were totally counted, whereas the national protocol does not explicitly requires the use of total counts nor subsampling or estimating procedures. Furthermore, determination level was set at family with some exceptions to the genus level, as for APAT & IRSA-CNR (2003).

Datasets obtained through this methodology are quantitative and can be used to calculate the STAR_ICM index (Buffagni & Erba, 2007).

This sampling and processing method will here hence be referred to as *standard sampling method*.

Figure 6 Phases of analysis of macroinvertebrate community (sampling, sorting, determination).

In order to specifically study minimum flow effects on macroinvertebrate community, in the second year of activity (2011) the standard sampling method was modified.
All introduced changes were planned to enhance information about the connections between community and environmental characteristics while not increasing too much field and laboratory effort and allowing to use collected data both for STAR_ICMi calculation and experimental analysis.
Changes in sampling protocols concern:

1. Sampling frequency, which in standard sampling procedures is fourth a year, following seasonality; for the present study, sampling in Ticino river in 2011 was instead performed following hydrograph (Figure 7).

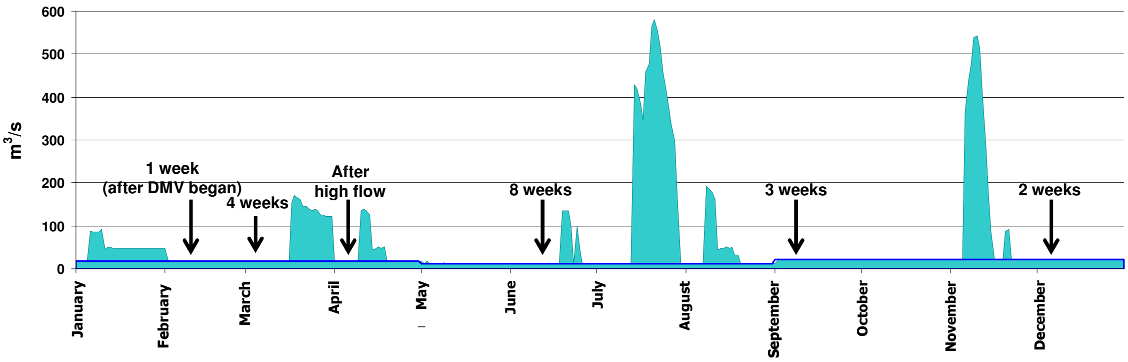


Figure 7 Sampling frequencies in Ticino river during 2011, at different temporal distances from the beginning of minimum flow periods.

2. Sampling method, collecting additional data about environmental characteristics related with flow and morphology at the microhabitat level. This was performed storing and analysing separately the 10 subsamples composing each single sample. This allows to study differences between communities sampled in different positions along the river transect, characterized by different substrates and different hydraulic conditions. The latter were measured for each subsample only in Adda river, as:
   - water column depth at the centre of the sampling quadrat through a graduated stick (numeric);
   - flow velocity at 2/3D at the centre of the sampling quadrat through a flow tracker (numeric);
   - distance of the sampling quadrat from banks through a telemeter (numeric).

   Other additional data were also taken for each subsample:
   - substrate typology as from Buffagni & Erba (2007) (factorial);
   - presence of periphytic vegetation on the substrate within the sampling quadrat (boolean);

- presence of riparian vegetation shading the area within the sampling quadrat when the sun reached its zenith (boolean);
- flow type as from Buffagni et al. (2007) (factorial).

Additional subsamples were taken for those substrates which covered less than 50% of the riverbed, in order to have a minimum number of subsamples of 5 per substrate typology per each sample.

This sampling and processing method will here hence be referred to as *experimental sampling method*.
Sampling of macroinvertebrates associated with hydro-morphological measures such as depth, flow velocity and substrate characteristics, were firstly used by Gore and Judy (1981) for the definition of suitability curves and many authors already highlighted the importance of hydraulic and morphologic factors in shaping macroinvertebrate community characteristics (e.g. Jowett, 2003; Brooks et al., 2005).
Changes in standard sampling method were applied into five selected sample sites, chosen because of their neighbourhood to water withdrawal structures and because they are representative of different environmental typologies along the watercourses. Sampling sites on which experimental sampling methods were applied are summarized in Table 5.
All collected samples are listed in Table 4.

Table 4 List of macroinvertebrate collected samples.

River	Date	Standard sampling method	Experimental sampling method
Adda	January 2010	x	
Adda	April 2010	x	
Adda	September 2010	x	
Adda	January 2011	x	x
Adda	April 2011	x	x
Adda	August 2011	x	x
Adda	December 2011	x	x
Ticino	December 2009	x	
Ticino	February 2010	x	
Ticino	April 2010	x	
Ticino	August 2010	x	
Ticino	December 2010	x	
Ticino	February 2011	x	x
Ticino	March 2011	x	x
Ticino	April 2011	x	x
Ticino	June 2011	x	x
Ticino	September 2011	x	x
Ticino	December 2011	x	x

Table 5 List of sites in which experimental sampling methods were applied.

River	Site	Sampling frequency changing	Replicates analysed separately	Flow parameters collection
Adda	ADS2		x	x
Adda	ADS3		x	x
Adda	ADS6		x	x
Ticino	TIC1	x	x	
Ticino	TIC4	x	x	

Data analysis

All numerical analysis were performed by using R 2.9.1 (R Development Core Team, 2009) or XLSTAT (version 2011.2.05; ®Addinsoft) .

Data were analysed in order to study:

1. influence of hydro-morphological factors on macroinvertebrate community
2. influence of minimum flow duration on macroinvertebrate community
3. influence of sampled area on accuracy of detected macroinvertebrate community in terms of taxonomical richness

Data collected by means of the experimental sampling procedure were also used to calculate the STAR_ICMi and to give a general overview of the rivers status.

In order to study the relationship between benthic community structure and hydraulic-morphologic parameters, as a starting point, a Principal Component Analysis (PCA) was performed using single subsamples as observations and values of eight selected metrics as variables. Chosen metrics are commonly used indexes to describe benthic communities (Table 6).

Table 6 Chosen metrics to describe benthic community.

Index	Reference	Name used in graphics and comments
ASPT	e.g. Armitage *et* al., 1983	ASPT
Log_{10}(Sel_EPTD+1)	Buffagni et al. 2004; Buffagni & Erba, 2004	EPTD
1-GOLD	Pinto et al., 2004	GOLD
Number of families	e.g. Ofenböck et al., 2004	n_families
Number of families EPT	e.g. Ofenböck et al., 2004; Böhmer et al., 2004	EPT
Shannon-Wiener diversity index	Shannon, 1948; e.g. Hering et al., 2004; Böhmer et al., 2004	Shannon
Density (individuals per replicate of 0.05 m^2)		Density
Ratio of EPT and Chironomidae abundances	EPA, 1989	EPT_Chironomidae

PCA was performed through R prcomp() function in the package stats.

Metrics which resulted to best explain the distribution of the dataset were than used to study the eventual effect of hydro-morphological factors on macroinvertebrate community, through ANOVAs and post hoc Tuckey tests (Siegel & Tukey, 1960), after previously detecting data normality through Shapiro-Wilk normality test (Shapiro & Wilk, 1965). For this purpose functions used are Shapiro.test(), aov() and TukeyHSD() in the package stats. This analysis was applied to data collected in Adda river, in sites ADS2, ADS3 and ADS6.

To study effects of minimum flow duration on benthic community, changes in benthic community along 2011 were compared with changes in entity and duration of minimum flow, indicated as the ratio *minimum flow duration / minimum flow entity*; this numeric value will be called *low flow index*. This analysis was applied to data collected in Ticino river, in sites TIC1 and TIC4.

Finally, data about subsamples were used to investigate effects of sampled area on detected richness at family level. Choosing the correct area to be sampled is indeed at the basis of the correct definition of biological communities (e.g. Cain, 1938; Gotelli & Colwell, 2001) and hence of consequent inferences. For this purpose, in order to create families-area curves, number of families found in each subsample of a substrate typology were combined in couples, than in triplets and so on (using `comb()` function in the package `utils`), till the maximum number of subsamples collected for that substrate. Mean number of families of all of the combinations of **n** subsamples represent each point of the families-area curve. The procedure was repeated for all the samples collected with the experimental sampling method.

Other biological communities

Besides macroinvertebrate communities, data about diatoms, macrophytes, fishes and physico chemical parameters were collected following standard national sampling and analysing methods. Data were than used to calculate quality indexes provided for Italian law (D.M. 260/2010) in order to actuate the WFD.

The river reach quality level for each indicator is defined as the similarity with a reference condition and calculated as a ratio between the index (or sub-indexes) value for the studied reach and the same values for the reference site (the so called EQR - Ecological Quality Ratio). Quality assessments resulting from the application of indexes were than used to determine the general ecological status of the studied watercourses, as the worst among all of the single indicators quality assessments.

Used sampling and analysing protocols and quality indexes are listed in Table 7.

Table 7 Sampling and analysing protocols for the definition of general river status as from WFD and DM260/2010.

Indicator	**Sampling – analyzing reference**	**Index**	**Index reference**
Diatom community	APAT 2007	ICMi (Inter Calibration Multimetric index)	Mancini & Sollazzo, 2009
Macrophytic community	APAT 2007	IBMR (Indice Biologique Macrophyitique en Riviere)	ENEA, 2009; ANFOR, 2003
Macroinvertebrate community	APAT 2007	STAR_ICMi (STAR Intercalibration Common Metric index)	Buffagni & Erba, 2007
Fish community	APAT 2007	ISECI (Indice dello Stato Ecologico delle Comunità Ittiche)	Zerunian et al., 2009
Physico-chemical parameters	APAT 2007	LIM_{eco} (Livello di Inquinamento da Macrodescrittori per lo stato ecologico)	D.M. 260/2010

1.1.4 Functional approach

Ecological functionality measurement

In order to study the functionality of river system and the influence of minimum flows on fluvial processes, the open-channel method was applied, following a scheme that was firstly purposed by Odum (1956). A river reach on Ticino river was selected for its being homogeneous from an hydrological point of view (i.e. no water inputs or outputs) and heterogeneous from a morphological point of view (i.e. with the alternation of pools, riffles, runs, strait areas and curved-braided areas…). This reach is defined by an upstream station called *Mazzini* and a downstream station called *Porto* (Figure 8).

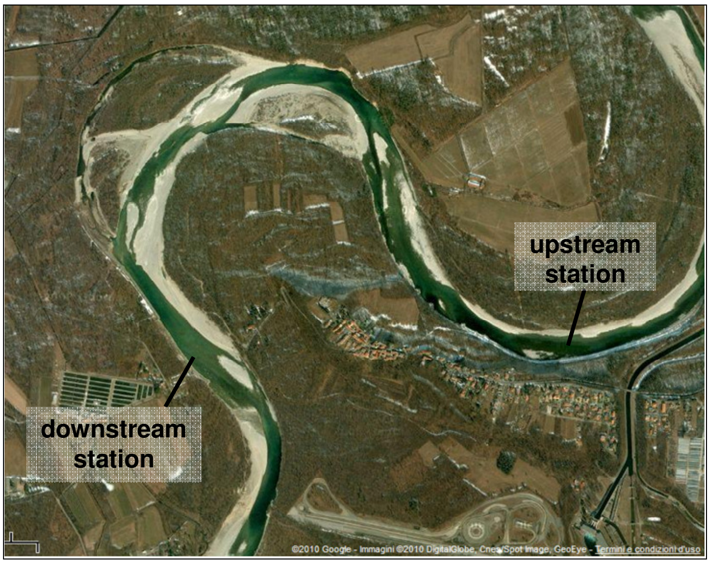


Figure 8 River reach chosen on Ticino for the ecological measures.

Dissolved oxygen concentration was measured in upstream and downstream stations in different moments during the day, comprehending the lighted period (assumed to be a period of photosynthetic production) and the dark period (assumed to be characterized solely by respiration). Measures were made taking into account lag time necessary for the water to pass from one station to the other one. This time was calculated based on current velocity (measured by means of a flow tracker) and distance between the stations. A general daily measuring scheme is represented in Table 8.

Table 8 Daily measuring scheme for fluvial functionality study.

Measure name	Measure number	Hour in downstream station
Pre-dawn	1	Just before dawn
Morning	2	Before the noon
Midday	3	Near the noon
Afternoon	4	After the noon
Sunset	5	Just after sunset

Measures were repeated during 2010, 2011 and 2012 in different seasons and with different flow values (Table 9).

Table 9 Dates and flow values of days in which data were collected for the fluvial functionality study.

Date	Year	Flow (m^3/s)	Minimum flow percentage of mean annual natural flow (%)
April 1st	2010	361	
April 20th	2010	92	
May 18th	2010	628	
May 25th	2010	260	
July 27th	2010	12	4
August 18th	2011	28	10
August 19th	2011	12	4
August 31st	2011	12	4
September 1st	2011	22	7.6
August 22nd	2012	28	10
August 24th	2012	22	7.6

A second study reach was identified and used additionally to the previous one during 2011 and 2012. This reach is defined by an upstream station called *Maddalena* and *Mazzini* as a downstream station, hence being just ahead the other reach (Figure 9). It was chosen because of the presence of a riparian freshwater environment with spring origin, partially connected to the river: with low flows it enters the river, while with high flows it becomes a lateral branch of the river.

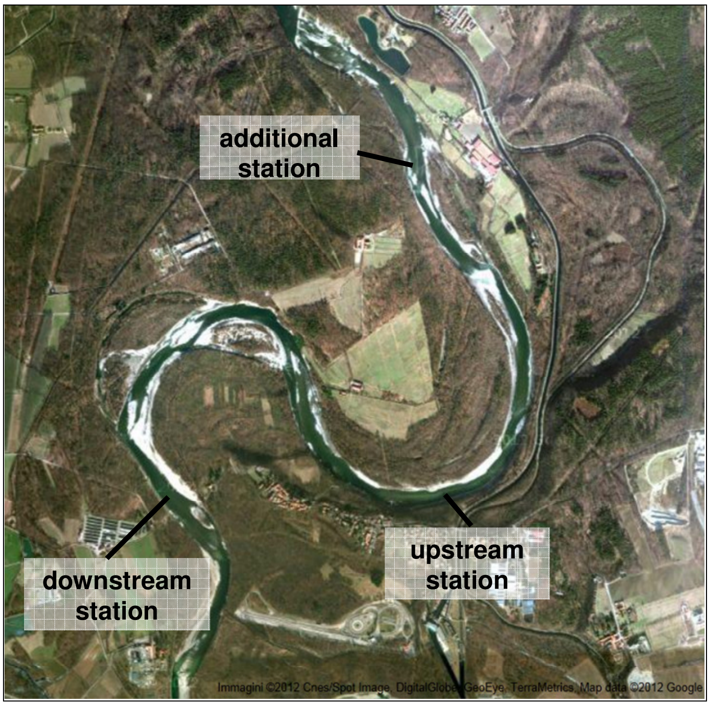


Figure 9 Additional river reach chosen on Ticino for the ecological measures.

Measures were taken by using a hand-held multiparameter sensor YSI Professional *Plus*, which allowed to record also values of other important parameters for aquatic life (pH, electrical conductivity, water temperature, dissolved oxygen saturation). In each of the measuring periods presented in Table 8 data about oxygen and other parameters were collected in continuous mode every 30’’ for 10 minutes, in order to have datasets comprehending short time variability, instead of single data.

During measures, water samples were taken to make laboratory analysis of the concentration of many ecologically important compounds, listed in Table 10 (Figure 10).

Table 10 Analysed parameters and relative methodological references.

Parameter	Analyzing reference
BOD_5 (mg/L)	Kit Lange LCK 554
COD (mg/L)	Kit Lange LCK 414
TN (mg/L)	Kit Lange LCK 138
$N\text{-}NO_3$ (mg/L)	Kit Lange LCK 339
$N\text{-}NO_2$ (mg/L)	Kit Lange LCK 541
$N\text{-}NH_4$ (mg/L)	Kit Lange LCK 304
TP (mg/L)	Kit Lange LCK 349
$P\text{-}PO_4$ (mg/L)	Kit Lange LCK 349
SST (mg/L)	APAT & IRSA-CNR 2090 - metodo B (2003)

Figure 10 Parameters measurement and water sampling in Ticino river for the ecological functionality measurement.

Data analysis

Collected data were analysed in order to answer to three different questions:

1. How do the measured parameters change in response to seasonality, day hours and flow?
2. How does fluvial metabolism changes with flow?
3. How does the presence of a riparian environment acts on fluvial metabolism and parameters in the main channel?

In order to answer to the first question, only data about *Porto* station were analysed. This question is particularly important since the range of values for many parameters is expected to have an influence on the aquatic biotic communities. Data about measured parameters were analyzed and represented through Principal Component Analysis and box and whiskers plots.

In order to understand how flow could influence fluvial metabolism (second question), Gross Primary Production, Net Primary Production, Respiration and Diffusion were calculated based on values of oxygen concentration as for Odum (1956):

$$\Delta O_2 = P - R + D_{in} + A \qquad (2)$$

Where ΔO_2 is the rate of change of dissolved oxygen per area, P is the rate of gross primary production per area, R is the rate of respiration per area, D_{in} is the rate of oxygen uptake by diffusion per area and A is the rate of drainage accrual.

A was considered negligible since the studied river transect was chosen for the absence of strong water incomes.

Difference in oxygen concentration between the two stations (mg/l) was corrected with flow value (m^3/s) and wetted area between the two stations (m^2), in order to get values of ΔO_2 expressed on an area basis ($g/m^2/h$).

Data about wetted area in different days (with different flow values) were calculated using HecRas (US Army Corps of Engineers, version 4.1), with data about water depth collected along many sections with a total station and a GPS receiver; an example of river section is shown in Figure 11.

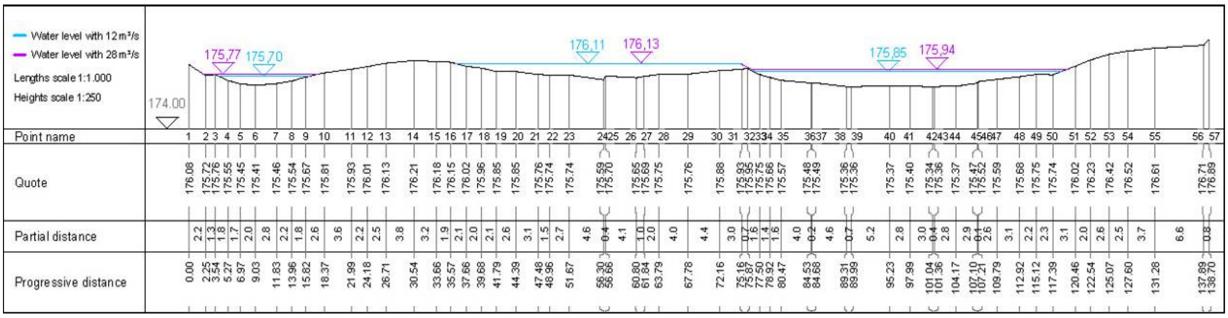


Figure 11 Example of section measured in Ticino river during 2011.

D_{in} was calculated as:

$$D_{in} = k_a * D_{mean} * z \qquad (3)$$

where k_a is the reaeration coefficient (day^{-1}), calculated as in (5) and (8); D_{mean} is the mean oxygen deficit, calculated as in (4); z is the reach mean depth (m);

$$D_{mean} = c_s - DO_{mean} \qquad (4)$$

where c_s is the oxygen saturation (mg/l) and DO_{mean} is the mean value of oxygen concentration (mg/l).

Reaeration coefficient was calculated through two different ways, which results were compared:

1. With the formula presented by McBride (2002):

$$k_a = 7.5 \cdot \Psi \cdot \left(\frac{5.3 \cdot \eta - \Phi}{\eta \cdot \Phi} \right)^{0.85} \qquad (5)$$

   where Ψ is a temperature correction factor, calculated as in (6); η a photoperiod correction factor, calculated ass in (7); Φ is the time lag between DO maximum and solar noon (h).

$$\Psi = 1.0241^{20-T} \qquad (6)$$

$$\eta = (f/14)^{0.75} \tag{7}$$

2. Through one of the methods proposed by Odum (1956):

$$k_a = \frac{\Delta O_{2_2} - \Delta O_{2_1}}{z \cdot \left(D_{mean_2} - D_{mean_1}\right)} \tag{8}$$

Total gross primary production (for the whole day period) was calculated as the integral of the polyline drawn by the connection of single points representing P value for each hour in which measures were conducted.

R is assumed to be constant during the 24 hours and can be calculated as the difference between ΔO_2 measured before the sunrise and the calculated oxygen diffusion rate.

Finally, data about GPP and R for the entire day were used to calculate P/R rates for each day of measurement.

All calculations were made on median values of oxygen concentration for each moment of measurement, since datasets appeared not to be normally distributed, by a Shapiro-Wilk normality test applied on single ten-minutes datasets.

4 Results and discussion

4.1 Hydrological patterns in Adda and Ticino rivers

Adda river

Hydrological data collected for the Adda river at the gauging stations listed in Table 1 during the studied years (2010-2012), show the typical rain-snow fluvial regime, with two periods of high flows in spring and autumn and two periods of low flows in winter and summer (Figure 12). This general pattern is maintained both upstream and downstream water diversion structures, even if differences in water use lead to differences in the instantaneous water volumes. In sites ADS1 and ADS2, strong importance of hydropower production lead to prolonged minimum flows, particularly during the winter months. Sites ADS4 and ADS5, were agricultural uses dominate, differences between high and low flows resulted smoothed and low flow periods were less predictable.

Days characterised by the presence of flows equal to minimum values overcome the 50% of the year in ADS2 and ADS3 and low flows were temporally dominant in all sites (Table 11).

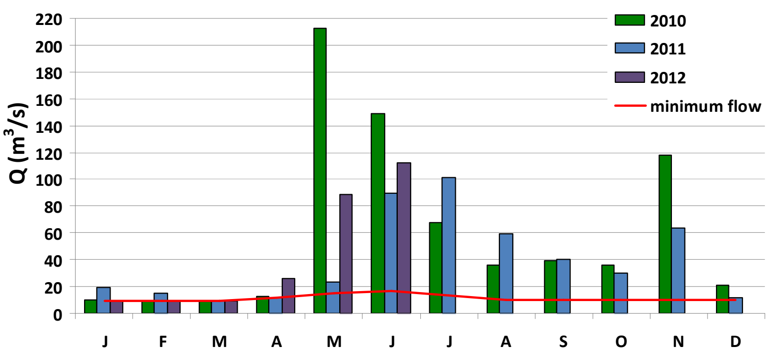


Figure 12 Mean monthly flows downstream Paderno dam on Adda river (site ADS1) during 2010-2012. Experimental minimum flows are also shown.

Table 11 Percentage number of days characterized by different flow classes in Adda river during 2010-2011 (MF = minimum flow).

Flow class	Downstream Paderno dam (ADS1)	Downstream Concesa dam (ADS2)	Downstream Rusca dam (ADS3)	Downstream Muzza canal (ADS4)	Downstream Vacchelli canal (ADS5)
MF	29%	51%	51%	0%	19%
MF + 1-50 m^3/s	44%	35%	35%	46%	37%
MF + 50-100 m^3/s	16%	5%	4%	37%	30%
MF + 100-200 m^3/s	5%	4%	5%	9%	7%
MF + 200 or more m^3/s	5%	3%	5%	8%	6%

Ticino river

Hydrology in Ticino river showed the same yearly pattern measured in the Adda river (Figure 13), even if the mean annual flows resulted higher (Table 12). Minimum flow values in the Ticino resulted maintained for a higher number of days/year (Table 13).

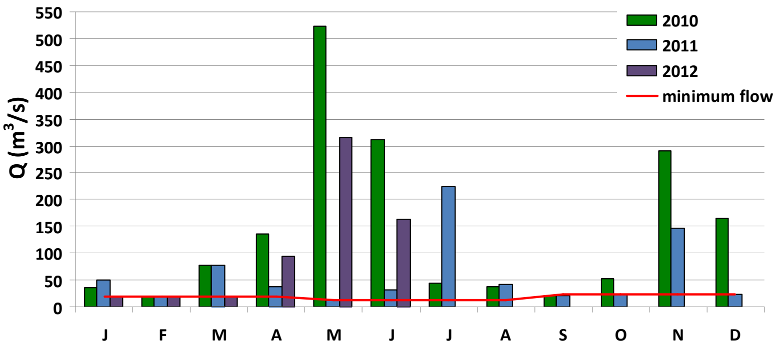


Figure 13 Mean monthly flows downstream Panperduto dam on Ticino river during 2010-2012. Experimental minimum flows are also shown.

Table 12 Mean annual flows in Adda and Ticino.

Year	Adda						Ticino	
	At lake exit	Downstream Paderno dam (ADS1)	Downstream Concesa dam (ADS2)	Downstream Rusca dam (ADS3)	Downstream Muzza canal (ADS4)	Downstream Vacchelli canal (ADS5)	At lake exit	Downstream Panperduto dam
2010	184	60	47	51	105	95	320	137
2011	161	40	28	31	77	58	239	59

Table 13 Percentage number of days characterized by different flow classes in Adda river during 2010-2011 (MF = minimum flow).

Flow class	Downstream Panperduto dam
MF	58
MF + 1-50 m^3/s	10
MF + 50-100 m^3/s	10
MF + 100-200 m^3/s	7
MF + 200 or more m^3/s	15

4.2 Overview of the general status of biotic communities in Adda and Ticino

Here the results of the application of standard monitoring schemes as required by the WFD are presented, distinguishing between the Adda and Ticino rivers.

1.1.5 <u>Adda river</u>

Diatoms community

Diatom community found in Adda river resulted taxonomically rich (mean species number 38 ± 7) all along the watercourse. Samples collected at the beginning of the summer period are characterized by lower richness and diversity (Figure 14), being generally dominated by one or few pioneer species, while at the end of the summer months the proceeding of the vegetative season along with a higher flow stability led to climax communities.

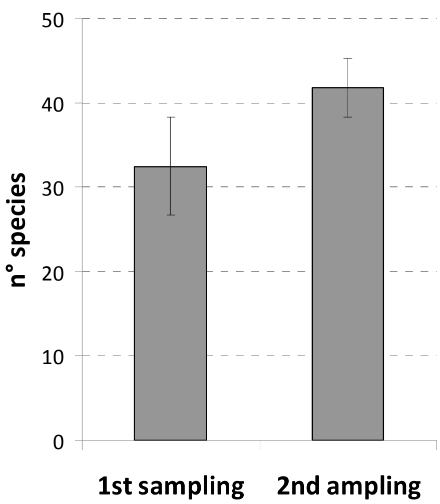


Figure 14 Mean ± SD number of diatom species found in Adda river during 2010 and 2011 in the first (June) and second (August – September) sampling periods.

Dominant diatoms belong to oligo-mesotrophic species, like *Cocconeis placentula*, *Reimeria sinuata* and *Achnanthidium minutissimum*, the latter two being more present during the first seasonal sampling because of their *r*-strategy. In the last two stations *Mayamaea atomus* and *Amphora pediculus*, typical of meso-eutrophic conditions, resulted the dominant *taxa*.

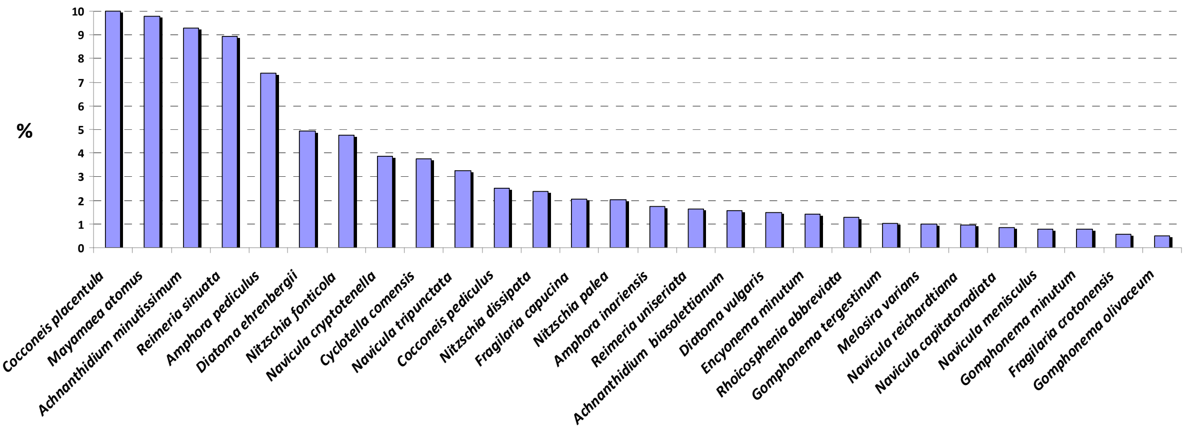


Figure 15 Mean relative aboundance of dominant diatom species calculated for Adda sites for 2010, 2011 and 2012.

As presented in Table 14, in sites ADS6 and ADS7 river quality status, calculated by applying the Intercalibration Common Metric index (ICMi), resulted visibly lower than in other sites, in relation to the worst water quality (high nutrients and organic concentrations). For all the other sites, quality classification level was “good” to “high”.

Table 14 Values of the Intercalibration Common Metric index (ICMi) in the form of Ecological Quality Ratio (EQR_ICMi) for Adda sites in 2010, 2011 and 2012. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

Year	Month	ADS1	ADS2	ADS3	ADS4	ADS5	ADS6	ADS7
2010	June	0.92	0.95	0.98	0.99	1.04	0.8	0.68
	September	1.03	0.95	0.86	1.06	0.92	0.98	0.89
2011	June	0.97	0.89	0.78	0.94	0.83	0.63	0.54
	August	0.99	0.91	0.9	0.89	1.01	0.93	0.82
2012	June	0.94	0.88	0.82	0.86	1.03	0.62	0.66

Macrophytes community

Macrophyte community sampled in Adda during 2010 and 2011 resulted poorly strudtured in number of *taxa* (mean species or genus number 11 ± 6) and poorly developed in terms of biomass, being characterised by low cover percentage (22.3 % ± 17.5). The strongly dominant component of the community resulted the periphytic one, composed of macroalgae or mosses (20.1 % ± 21.0, Figure 16).

The low expansion of macrophyte and particularly of phanerogams development appeared to be controlled by the spring high flows, for which the hydraulic force is able to move substrate (principally composed by cobbles of 6 to 20 cm) and to delay plant growth till the middle or late summer. Phanerogams are hence limited to lateral low velocity areas, while algae in late summer reach high cover values all along the river bed.

Limited macrophytic development had lead to the impossibility to make reliable samplings in some of the sites, especially during 2011 (see missing data in Table 15).

Dominant *taxa* are common, mesotrophic algae and mosses species, such as *Cladophora* sp. (Dodds & Gudder, 1992), *Rhizoclonium* sp. and *Fontinalis antipyretica* (Figure 17). Among phanerogams many alloctonous species were found: *Elodea canadensis*, *Polygonum persicaria*, E*lodea nuttallii*, even if they were not widely distributed.

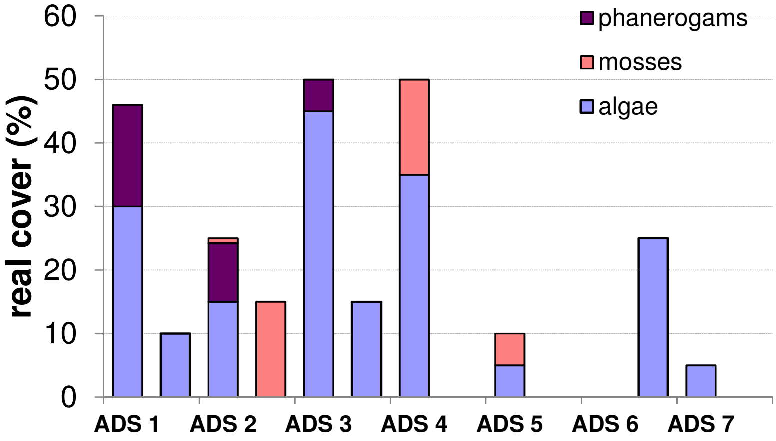


Figure 16 Percentage cover of macrophytes in seven sites on Adda, divided by group. Data about 2010 in ADS6 and data about 2011 in ADS4, ADS5 and ADS7 are missing because of strong lack of macrophytes cover.

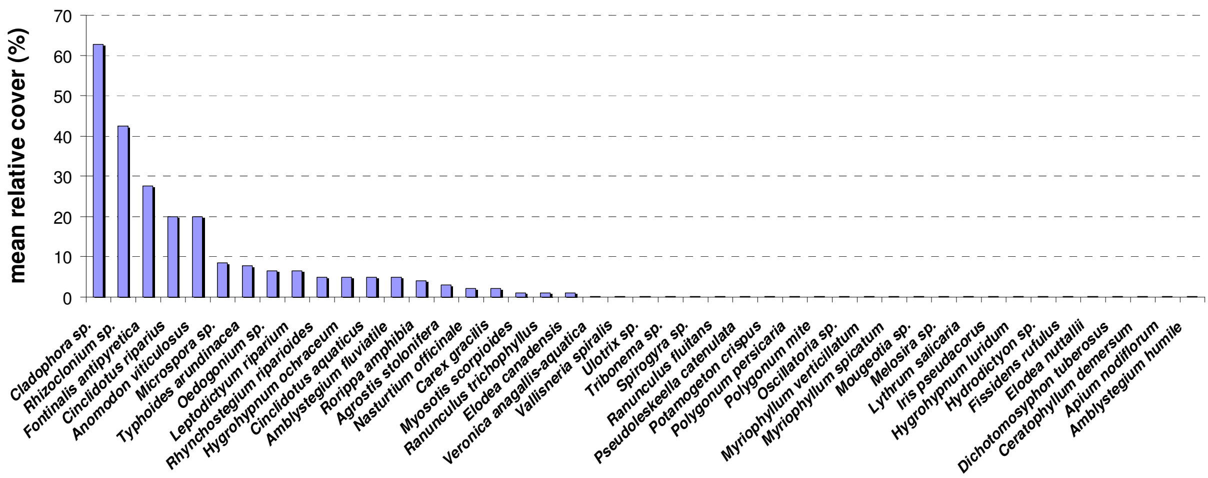


Figure 17 Mean relative cover of dominant taxa calculated for Adda sites for 2010 and 2011 (at genus level for algae and at species level for phanerogams and mosses).

Despite the scarcity of macrophytes, the presence of *taxa* with oligotrophic preferences, such as *Microspora*, *Myosotis scorpioides*, *Fissidens rufulus*, *Hygrohypnum* sp. and *Cinclidotus* sp., drive the IBMR (Indice Biologique Macrophyitique en Riviere) to reach high values, compared to the reference communities. This happened except for the last two sites (ADS6 and ADS7), where highly mobile substrate and poor chemical water quality (see paragraph on physical and chemical parameters), lead to the quality falling to "moderate" or "poor" level. IBMR values calculated for the two samplings in the seven sample sites and relative quality levels are reported in Table 15.

Table 15 Values of the Indice Biologique Macrophyitique en Riviere (IBMR) in the form of Ecological Quality Ratio (EQR_IBMR) for Adda sites in 2010 and 2011. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

Year	ADS1	ADS2	ADS3	ADS4	ADS5	ADS6	ADS7
2010	0.78	0.90	0.82	1.12	1.08	nodata	0.57
2011	0.81	0.88	0.88	nodata	nodata	0.73	nodata

Macroinvertebrate community

The macroivertebrate communities in Adda river resulted strongly influenced by the longitudinal hydro-morphological gradient of the river reach included between the first and the last sampling site. Natural gradients, such as the decrease of the substrate granulometry (Table 16) and flow turbulence just by themselves can play a role in shaping the taxonomic structures of the benthic communities. Moreover, the longitudinal changing of the anthropogenic perturbation, due to different land uses and water management systems, can make hydrological differences between sites increase (see Chapter 2). Invertebrate density and *taxa* richness thus decrease longitudinally (Figure 18). The communities resulted mainly composed by individuals belonging to Diptera (mostly Chironomidae), Tricoptera (largely Hydropsychidae) and Ephemeroptera (*Ephemerella* and *Baetis*), with local high densities of other *taxa*, such as Nerithidae and Naididae.

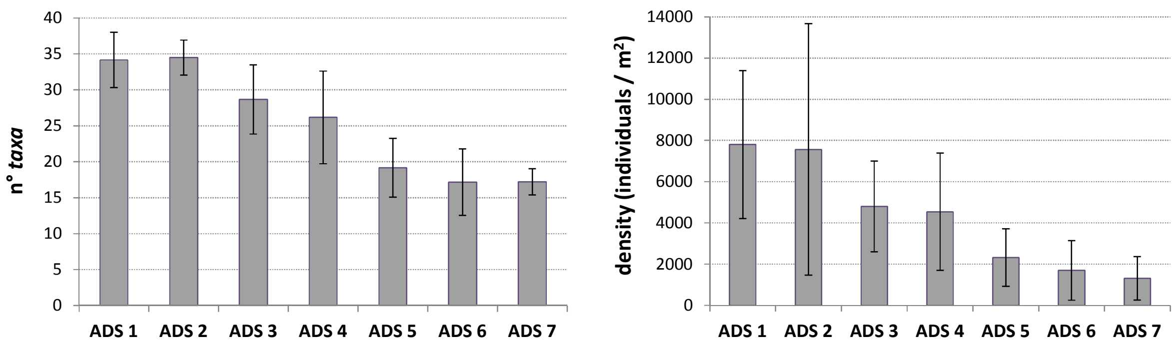


Figure 18 Longitudinal trend in richness and density in Adda river in the period 2010-2012 (mean±SD).

Table 16 Percentage cover of principal bed substrates present in Adda sites (MAC = *macrolithal*, MES = *mesolithal*, MIC = *microlithal*, GHI = *gravel*, SAB = *sand*).

Substrate typology	Diameter (cm)	ADS1	ADS2	ADS3	ADS4	ADS5	ADS6	ADS7
MAC	20 – 40	20	20	60		10		
MES	6 – 20	80	80	40	60	60	60	10
MIC	2 – 6				40	30	40	60
GHI	0.2 – 2							10
SAB	0.006 – 0.2							20

Results of the application of the STAR_ICMindex show a generally "good" status for the macroinvertabrate community, especially in ADS1 and ADS2, while quality decreases longitudinally, to a "moderate" quality level. This clearly reflects the nature of STAR_ICMi, which is a multiparametric index mainly based on richness sub-indexes (such as the family richness and EPT). Since these metrics could have a low direct connection with hydraulic conditions, a thoroughly study of the macroinvertebrate fauna, along with a critical use of potential sub-indexes, are present in Chapter 1.1.3.

Table 17 Values of the STAR Intercalibration Common Metric index (STAR_ICMi) in the form of Ecological Quality Ratio (EQR_STAR_ICMi) for Adda sites in 2010, 2011 and 2012. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

Year	Month	ADS1	ADS2	ADS3	ADS4	ADS5	ADS6	ADS7
2010	January	0.87	0.94	0.81	0.86	0.82	0.75	nodata
	April	0.88	0.83	0.93	0.92	0.83	0.70	0.71
	September	0.92	0.83	0.80	0.85	0.80	0.71	0.68
2011	January	0.82	0.96	0.58	0.75	0.75	0.62	0.61
	April	0.89	0.85	0.72	0.84	0.82	0.75	0.83
	August	0.89	0.97	0.89	0.76	0.75	0.72	0.72
	December	0.83	0.82	0.70	0.65	0.78	0.75	0.62
2012	March	0.86	0.86	0.88	0.84	0.79	0.74	0.69
	June	0.95	0.91	0.73	0.80	0.63	0.69	0.60

Fish community

Because of the dimensions and morphology of the Adda river, backpack electrofishing didn't result sufficient for a correct definition of the fish community. Data collected are hence the result of different samplings and sample methods (including scuba observations) applied during 2010 and 2011 and, thus, are semi-quantitative data. Species found during that period are listed in the Annex.

Among the captured fishes there were many species of community importance, listed in Annex II of Habitat Directive (Dir. 92/43/CEE); among these, Marble Trout (*Salmo trutta marmoratus*) and Padanian Goby (*Padogobius martensii*) are endemic species for Po plain and the first one have strong preference for cold, well oxygenated waters (Gandolfi et al., 1991). Nevertheless also many alien species were present; Wels Catfish (*Silurus glanis*) is among the most invasive and represents a serious problem for Italian freshwater communities.

Among the sampled, dominant and more widespread species are little gregarious fishes, like Telestes (*Leuciscus souffia muticellus*), Freshwater blenny (*Salaria fluviatilis*), European Bullhead (*Cottus gobio*) and Padanian Goby.

Community structure is the result of species biogeography and many different anthropogenic impacts, such as presence of wires (in many cases impassable wires), introduction of alien species, flow management and fishing. ISECI (Indice dello Stato Ecologico delle Comunità Ittiche) was defined to give a synthetical response to all of these aspects, through the evaluation of different aspects of community structure. Its application in this case gives a general positive judgment of the quality status of the investigated communities (see Table 18).

Table 18 Values of Index of Ecological Status of Fish Communities (Indice dello Stato Ecologico delle Comunità Ittiche - ISECI) for Adda sites for the period 2010-2011. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

	ADS1	ADS2	ADS3	ADS4	ADS5	ADS6
ISECI	0.59	0.64	0.68	0.81	0.68	0.55

Physical and chemical parameters

Macropollutants in Adda river showed generally low concentrations in sites ADS1, ADS2 and ADS4, while in other sites nutrients and organic carbon were frequently present in high concentrations. Some of the measured parameters showed a decreasing concentration trend with increasing flows, following a typical dilution curve (Figure 19).

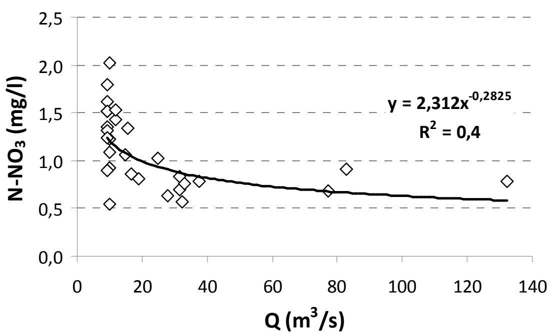


Figure 19 Dilution curve for nitric nitrogen in Adda site ADS2 (data about 2010, 2011 and 2012).

Collected concentrations of nitric nitrogen, ammonia nitrogen, total phosphorus and dissolved oxygen deficit were used to calculate LIM_{eco} index, which classified Adda sites in a generally "high" to "good" quality status, unless for ADS3, ADS5, ADS6 and ADS7, where the quality level many times decreased to "moderate" (Table 19).

Table 19 Values of the Macropollutants Pollution Level for ecological status (Livello di Inquinamento da Macrodescrittori per lo stato ecologico – LIM_{eco}) for Adda sites in 2010 and 2011 and 2012. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

Year	Month	ADS1	ADS2	ADS3	ADS4	ADS5	ADS6	ADS7
2009	December	0.88	0.69	0.50	0.75	0.69	0.69	nodata
2010	January	0.88	0.69	0.78	0.81	0.88	0.88	nodata
	February	0.75	0.69	0.66	0.59	0.59	0.69	nodata
	March	0.75	0.56	0.66	0.47	0.47	0.41	0.56
	April	0.88	0.69	0.50	0.75	0.88	0.69	0.69
	May	0.69	0.75	0.75	0.75	0.75	0.75	0.75
	June	0.63	0.63	0.75	0.75	0.81	0.56	0.69
	July	1.00	0.75	0.75	0.81	0.81	0.69	0.56
	August	0.75	0.88	0.88	0.88	0.81	0.81	0.56
	September	0.88	0.88	0.75	0.75	0.75	0.75	0.75
	October	nodata	0.69	0.75	0.75	0.75	0.75	0.69
	November	0.56	0.75	0.63	0.75	0.63	0.63	0.75
	December	0.88	0.75	0.63	0.69	0.69	0.69	0.69
2011	January	0.75	0.88	0.63	0.69	0.81	0.81	0.81
	February	0.88	0.69	0.47	0.69	0.69	0.56	0.69
	March	0.75	0.44	0.56	0.81	0.81	0.63	0.81
	April	0.75	0.56	0.38	0.81	0.81	0.81	0.69
	May	0.88	0.75	0.56	0.69	0.81	0.56	0.44
	June	0.88	0.88	0.88	0.81	0.81	0.81	0.81
	July	0.88	0.88	0.88	0.88	0.88	0.81	0.81
	August	1.00	0.88	0.75	0.75	0.81	0.56	0.56
	September	1.00	0.63	0.50	0.88	0.81	0.63	0.81
	October	0.75	0.63	0.50	0.75	0.44	0.69	0.50
	November	1.00	0.63	0.75	0.75	0.88	0.81	0.81
	December	0.75	0.69	0.56	0.81	0.69	0.69	0.69
2012	January	0.88	0.81	0.38	0.69	0.81	0.69	0.50
	February	0.88	0.81	0.47	0.69	0.81	0.69	0.44
	March	0.75	0.56	0.41	0.38	0.81	0.44	0.44
	April	0.75	0.56	0.41	0.56	0.56	0.50	0.50
	May	0.75	0.75	0.75	0.75	0.88	0.81	0.88
	June	0.88	0.88	0.88	0.88	0.88	0.81	0.81

Longitudinal decreasing in water quality was similar to the one of diatom and macroinvertebrate communities and certainly affects their indexes values, which followed the same trend as for LIM_{eco}.

1.1.6 Ticino river

Diatoms community

All along the studied Ticino reach, the diatom community richness resulted lower than in Adda river (mean species number 29 ± 5), with a strong dominance of *Achnanthidium minutissimum* all along the studied reach. As for Adda river, samples collected at the beginning of the summer period were characterized by lower richness and diversity (Figure 14), being generally dominated by one or few pioneer species, while at the end of the summer proceeding of the vegetative season along with flow stability have led to climax communities.

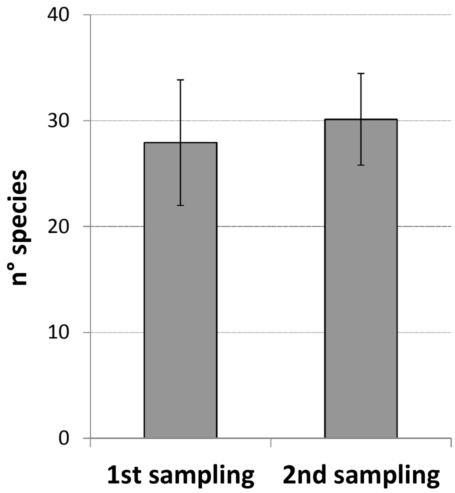


Figure 20 Mean ± SD number of diatom species found in Ticino river during 2010 and 2011 in the first (June) and second (August – September) sampling periods.

Dominant diatoms belong to oligo-mesotrophic species, as *Achnanthidium minutissimum*, *Cocconeis placentula* and, just in the two last sites, *Reimeria sinuata* and *Fragilaria capucina* (Figure 21). The low relative abundance of Acnanthidium minutissimum and the presence of *Fragilaria capucina* (a pelagic species) in site TIC4 indicates a more stable environment with the presence of slow current patches.

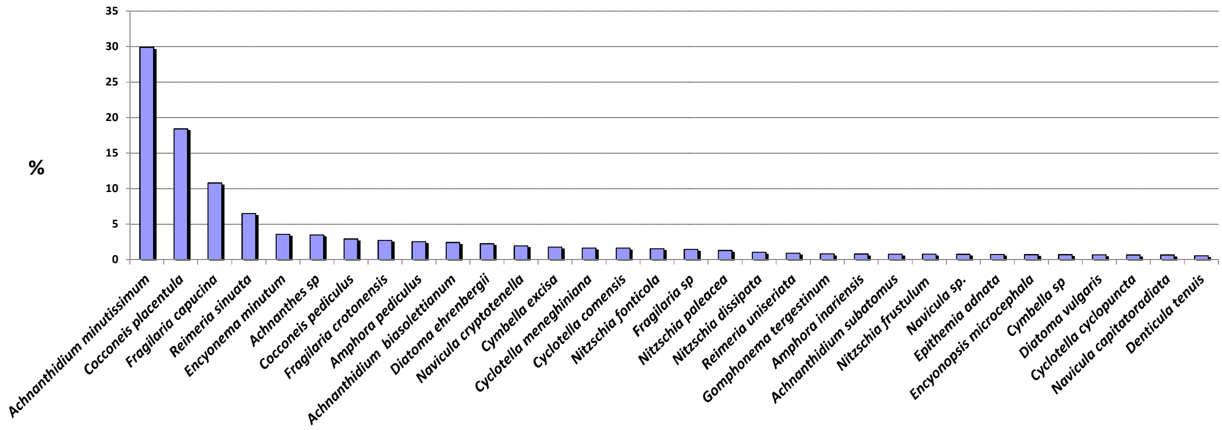


Figure 21 Mean relative abundance of dominant diatom species calculated for Ticino sites for 2010, 2011 and 2012

As presented in Table 20, the quality status of the Ticino river, calculated by applying the Intercalibration Common Metric index (ICMi), resulted always high.

Table 20 Values of the Intercalibration Common Metric index (ICMi) in the form of Ecological Quality Ratio (EQR_ICMi) for Ticino sites in 2010, 2011 and 2012. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

Year	Month	TIC1	TIC2	TIC3	TIC4
2010	July	1.15	1.29	1.37	1.11
	September	1.03	1.22	1.27	1
2011	June	1.11	0.97	1.06	0.97
	September	1.11	1.11	1.15	1.27
2012	July	1.02	1.02	0.95	1.09

Macrophytes community

The macrophyte community in Ticino river during 2010 and 2011 resulted more developed than in Adda river, even if dominated by few periphytic macroalgae genera, while Phanerogams were scarce in cover but present with many species (mean phanerogams richness 10 ± 3); mosses were almost absent (Figure 22). Mean *taxa* richness and cover percentage were higher than in Adda (respectively 16 ± 5 and 64 ± 25).

Dominant *taxa*, including *Cladophora* sp., *Hydrodictyon* sp., *Spirogyra* sp. and *Oedogonium* sp., are widespread algal genera, characteristic of mesotrophic freshwaters (Dodds & Gudder, 1992; Cambra & Aboal, 1992). Only two phanerogam *taxa* were locally present with high percentages: the nuisance *Lagarosiphon major* in slowly flowing waters and *Ranunculus fluitans* in fast flowing waters (Figure 23).

Macrophyte development appeared to be reduced after periods of elevated discharges; indeed reliable samplings were not possible during the first part of summer 2010 because of too scarce macrophytic development, while in summer 2011, high spring flows delayed till July made macrophyte community more rarefied at the end of the summer (marked as 2011b in Figure 22).

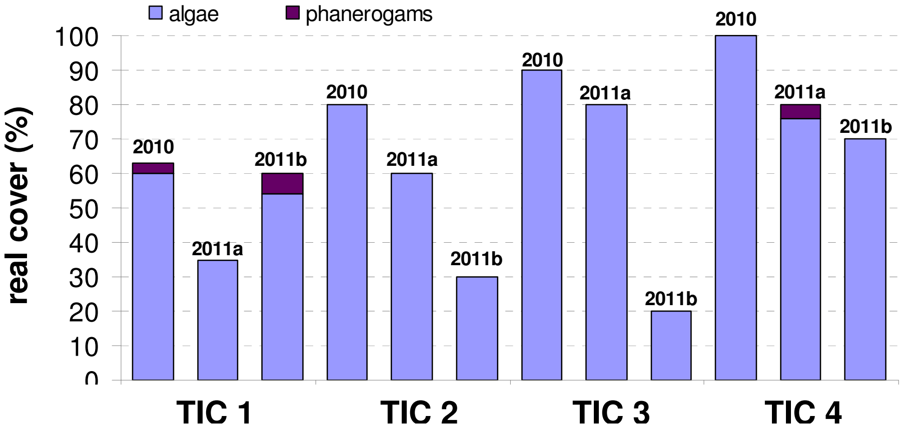


Figure 22 Percentage cover of macrophytes in the four sites on Ticino, divided by group.

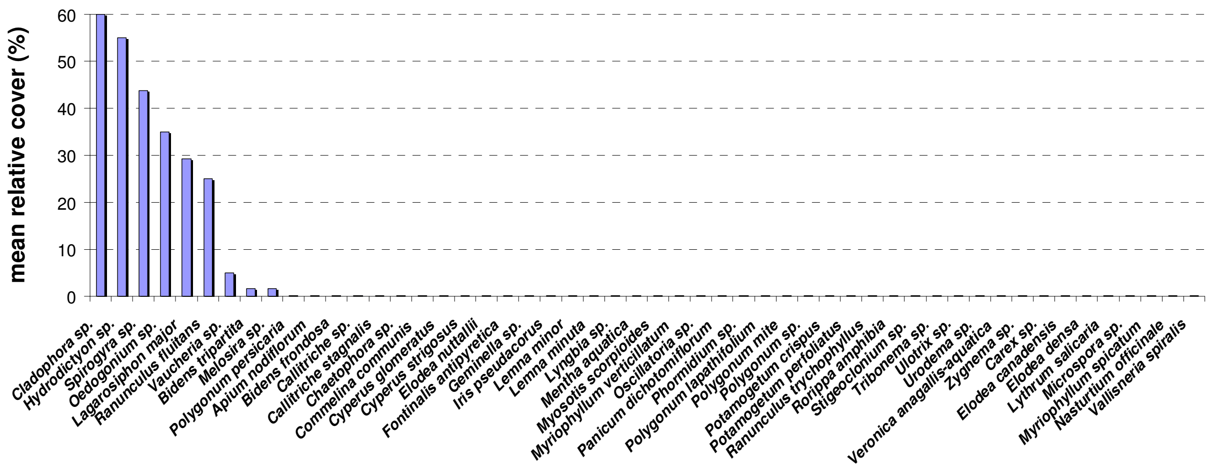


Figure 23 Mean relative cover of dominant *taxa* calculated for Ticino sites for 2010 and 2011 (at genus level for algae and at species level for phanerogams and mosses).

While macrophyte cover was sensible to high flows, species richness was dictated principally by ongoing of vegetative season, thus making IBMR(Indice Biologique Macrophyitique en Riviere) reach higher values at the end of summer (September 2010 and 2011), than in July 2011 (Table 21).

Table 21 Values of the Indice Biologique Macrophyitique en Riviere (IBMR) in the form of Ecological Quality Ratio (EQR_IBMR) for Ticino sites in 2010, 2011 and 2012. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

Year	Month	TIC1	TIC2	TIC3	TIC4
2010	September	0.82	0.88	0.86	0.83
2011	July	0.75	0.77	0.76	0.77
	September	0.85	0.81	0.85	0.86

Macroinvertebrate community

Macroinvertebrate community in Ticino river showed less longitudinal variability in *taxa* richness and density (Figure 24) than in Add; this finding is related to the low morphological variation of the riverbed structure and substrate granulometry. Principal substrates typologies present in Ticino sites, sampled for macroinvertebrate collecting (almost only cobbles), are listed in Table 22.

Community is mainly composed of individuals belonging to Tricoptera (mostly Hydropsychidae) Diptera (mainly Chironomidae) and Ephemeroptera (*Baetis* and *Ephemerella*), with local and temporary high numbers of other *taxa*, such as *Caenis*, Psychomyidae and Naididae.

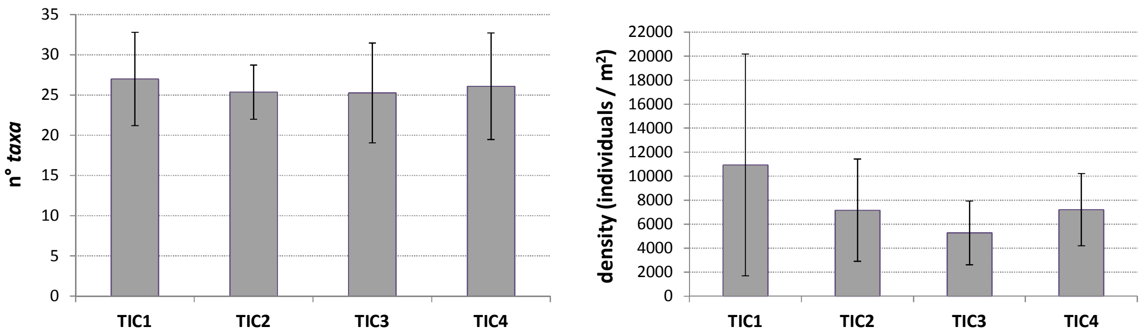


Figure 24 Longitudinal trend in richness and density in Ticino river in the period 2010-2012 (mean±SD).

Table 22 Percentage cover of principal substrates present in Ticino sites (MAC = *macrolithal*, MES = *mesolithal*, MIC = *microlithal*, GHI = *gravel*, SAB = *sand*).

Substrate typology	Diameter (cm)	TIC1	TIC2	TIC3	TIC4
MAC	20 – 40	30	20	30	20
MES	6 – 20	70	80	50	80
MIC	2 – 6			20	

Results of the application of the STAR_ICMindex show a generally “good” quality status of the macroinvertabrate community (Table 23).

Table 23 Values of the Multimetric Intercalibration STAR index (STAR_ICMi) in the form of Ecological Quality Ratio (EQR_STAR_ICMi) for Ticino sites in 2010, 2011 and 2012. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

Year	Month	TIC1	TIC2	TIC3	TIC4
2010	December	0.77	0.81	0.92	0.81
	February	0.83	0.75	0.94	0.67
	July	0.75	0.82	0.64	0.78
	August	0.87	0.79	0.91	0.76
2011	February	0.82	0.84	0.84	0.73
	March	0.77	nodata	nodata	0.81
	April	0.81	0.80	0.82	0.80
	June	0.94	0.82	0.86	0.80
	September	0.90	0.87	0.82	0.78
	December	0.74	0.66	0.63	0.61
2012	March	0.70	0.80	0.76	0.65
	June	0.77	0.64	0.80	0.86

Deepening in the study of macroinvertebrate fauna is present in Chapter 4.3.

Fish community

Semi-quantitative data were collected for the fish fauna in Ticino river through backpack electrofishing and scuba observations during 2010 and 2011.

As for the Adda river, many species of community importance, listed in Annex II of Habitat Directive, were captured, such as Italian Loach (*Sabanejewia larvata*) and Padanian Goby. Salmonids were absent.

Alien species (such as Wels Catfish, European Bitterling - *Rhodeus sericeus amarus*, Roach - *Rutilus rutilus*) were present particularly in the last two sites (TIC3 and TIC4).

Dominant and more widespread species were, as for Adda, little gregarious fishes, like Telestes, Italian Minnow (*Phoxinus phoxinus*), Freshwater blenny (*Salaria fluviatilis*), and Padanian Goby, Italian Spined Loach (*Cobitis taenia bilineata*); and also Italian Barbel (*Barbus plebejus*).

ISECI (Indice dello Stato Ecologico delle Comunità Ittiche) defines status of fish community in Ticino river good for the first two sites and moderate for the last two, in relation to the stronger presence of alien species (Table 24).

Table 24 Values of Index of Ecological Status of Fish Communities (Indice dello Stato Ecologico delle Comunità Ittiche - ISECI) for Ticino sites for the period 2010-2011. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

	TIC1	TIC2	TIC3	TIC4
ISECI	0.62	0.61	0.55	0.55

Physical and chemical parameters

Macropollutants in Ticino river showed generally low concentrations and no clear relationship with discharges can be detected (Figure 25).

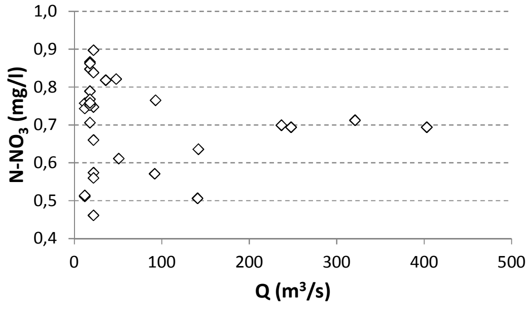


Figure 25 Distribution of nitric nitrogen concentration in response to flow value in Ticino site TIC1 (data about 2010, 2011 and 2012).

Collected data on nitric nitrogen, ammonia nitrogen, total phosphorus and dissolved oxygen deficit were used to calculate LIM_{eco} index, which classified Ticino sites always in a "high" or "good" quality status (Table 25).

Table 25 Values of the Macropollutants Pollution Level for ecological status (Livello di Inquinamento da Macrodescrittori per lo stato ecologico – LIM_{eco}) for Ticino sites in 2010, 2011 and 2012. Different colours represent different quality levels (*blue* = high; *green* = good; *yellow* = moderate; *orange* = poor; *red* = bad).

Year	Month	TIC1	TIC2	TIC3	TIC4
2009	December	0.75	0.88	0.88	0.88
2010	January	0.88	0.88	0.88	0.75
	February	0.88	0.88	0.88	0.88
	March	0.88	0.88	0.88	0.75
	April	0.75	0.75	0.88	0.63
	May	0.88	0.75	0.88	0.75
	June	0.75	0.69	0.75	0.56
	July	0.75	0.50	0.75	0.75
	August	0.88	0.88	0.88	0.75
	September	0.88	0.81	0.69	0.69
	October	1.00	1.00	0.88	0.88
	November	0.75	0.75	0.75	0.75
	December	0.88	0.88	0.88	0.88
2011	January	0.75	0.75	0.88	0.88
	February	0.69	0.75	0.88	0.88
	March	0.75	0.75	0.88	0.75
	April	0.56	0.69	0.88	0.66
	May	0.88	0.69	0.88	0.75
	June	0.75	0.69	0.69	0.69
	July	1.00	1.00	0.75	0.75
	August	0.88	0.50	0.88	0.69
	September	1.00	1.00	0.75	0.78
	October	1.00	1.00	0.88	0.75
	November	0.75	0.88	0.88	0.75
	December	0.88	0.88	0.88	0.88
2012	January	0.88	0.88	0.88	0.75
	February	0.88	0.88	0.88	0.88
	March	0.63	0.88	0.88	0.63
	April	0.75	0.75	0.75	0.63
	May	0.75	0.56	0.63	0.56
	June	0.75	0.81	0.56	0.56

1.1.7 General status of biotic communities

In Table 26 general quality status of Ticino and Adda sites was derived by using the worst level among those that were defined with the biological and abiotic parameters.

Table 26 General ecological status for rivers Adda and Ticino as from WFD (Dir. 2000/60/CE). Quality levels of each indicator are mean values computed using a two year dataset (2010 - 2011).

	ADS1	ADS2	ADS3	ADS4	ADS5	ADS6	ADS7	TIC1	TIC2	TIC3	TIC4
Diatoms	0.98	0.93	0.88	0.97	0.95	0.84	0.73	1.10	1.15	1.21	1.09
Macrophytes	0.80	0.89	0.85	1.12	1.08	0.73	0.57	0.81	0.82	0.82	0.82
Macroinvetebrates	0.87	0.89	0.78	0.80	0.79	0.71	0.70	0.82	0.80	0.82	0.76
Fish	0.59	0.64	0.68	0.81	0.68	0.55	nodata	0.62	0.61	0.55	0.55
Physical-chemical	0.82	0.72	0.66	0.75	0.75	0.79	0.69	0.83	0.80	0.83	0.76
River status	mode-rate	good	good	good	good	mode-rate	poor	good	good	mode-rate	mode-rate

As already highlighted, the quality status, as detected by applying national protocols, gives no specific information about the potential causes of alteration, which knowledge is highly important for improving remediation actions for the sites where GES (Good Ecological Status) is not reached. In Adda and Ticino this aspect happens in 5 sites upon 11, leading to a lack of indications about river management decisions to be taken, in order to restore river ecosystem quality. Another difficulty in interpreting the monitoring results lies in the different responses between different indicators: while chemical quality level (calculated through LIM_{eco}) is always high, bioindicators linked to a trophic index (macrophytes and diatoms), clearly show a longitudinal quality decrease in Adda river, highlighting an overestimation problem of LIM_{eco} and probably also the inadequacy of those indexes to catch communities responses to their real perturbation factors. Indeed these could be not always related to trophy and, as appears from presented data, in the case of macrophytes are often related to flow velocity and substrate instability.

Moreover, a relevant problem in the application of this monitoring system in lowland rivers is the absence of specific reference sites for this environment; this because of the absence of completely unperturbed sites on lowland Italian rivers. Ecological Quality Ratios (EQR) for these rivers are therefore calculated based on theoretical reference values lacking of the required precision.

Besides of the intrinsic problems lying in each of the applied metrics, for the aims of the present study an inadequacy of both indexes and indicators themselves arises, since their development never took into account the necessity to detect effects of altered flows.

4.3 Structural approach

In order to get over the problem of the inadequacy of the discussed indicators for the detection of low flow ecological effects, in this chapter the results of an alternative use of macroinvertebrate community are presented.

1.1.8 Influence of hydraulic and local parameters on benthic macroinvertebrate communities

In order to chose a biological metric that could synthetically describe differences between invertebrate communities sampled in different subsamples, an ordination analysis (PCA) was performed using commonly applied community descriptors (see Chapter 1.1.3).

PCA results show a first component explaining 41.3 % of the total variability, that summarizes the *taxa* richness and diversity values for the different subsamples. The second axis (21.7 %), instead, is correlated with samples density ($R^2_{dennsity\text{-}PC2}$= -0.631; Figure 26).

EPT values were chosen to synthetically describe community richness, since this index resulted to be, among the studied ones, the one which showed the higher correlation with the principal component ($R^2_{EPT\text{-}PC1}$ = -0.48).

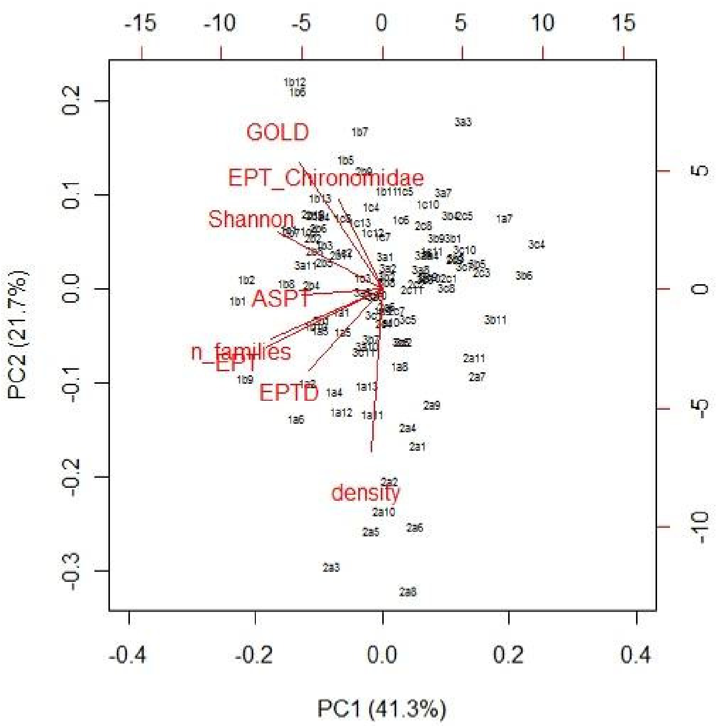


Figure 26 Principal Component Aanalysis (PCA) ordination graph of values of benthic macroinvertebrate metrics for different subsamples collected in Adda during 2011.

These results were also confirmed by a PCA applied to a wider dataset (comprehending also data from Ticino river). The latter PCA shows an ordination and correlation values between metrics and principal components similar to those of the first one (Figure 27; $R^2_{EPT\text{-}PC1}$ = -0.50; $R^2_{dennsity\text{-}PC2}$ = -0.66).

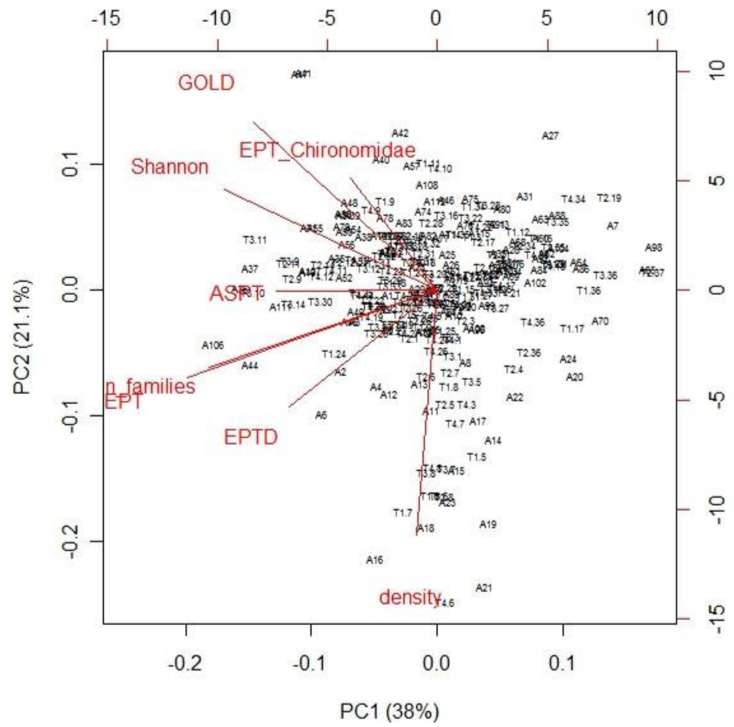
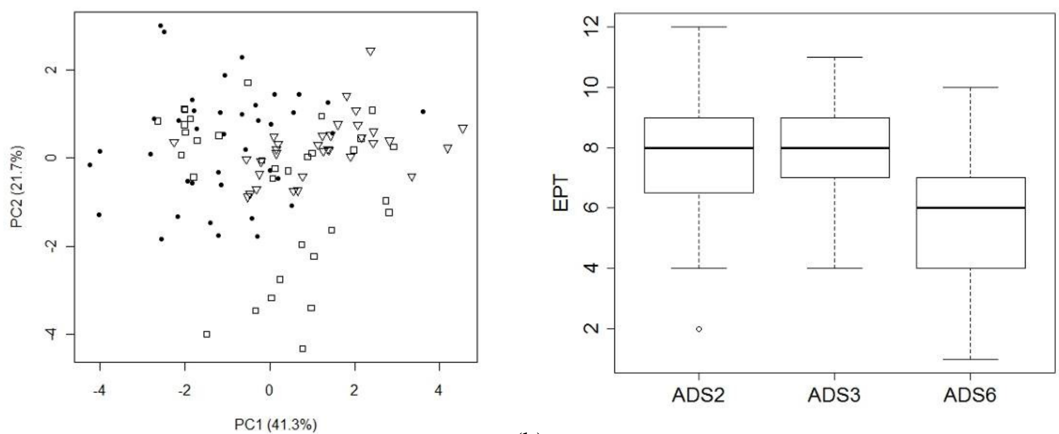


Figure 27 Principal Component Aanalysis (PCA) ordination graph of values of benthic macroinvertebrate metrics for different subsamples collected in Adda and Ticino during 2011.

On the PCA graph the observations result plotted with apparent no ordination about substrate typology, while they seem to be slightly ordered in response to sampling site (Figure 28(a)); indeed, EPT is significantly lower in ADS6 than in other sites (Figure 28(b), Table 27 and Table 28).



(a) (b)

Figure 28(**a**) Distribution of replicates relative to different Adda sampling sites in the PCA ordination graph (full circles = ADS2, quadrats = ADS3, triangles = ADS6); **(b)** box and whiskers plot of the EPT values relative to the subsamples collected in different Adda sampling sites.

Table 27 Two-way ANOVA with EPT as dependent variable and Adda sampling site (*site*) and substrate typology (*substrate*) as factors. In italics are highlighted factors that show significant difference between groups ($p < 0.001$).

Factors	Df	Sum Sq	Mean Sq	F value	Pr (>F)
Site	*2*	*88.02*	*44.01*	*11.5221*	*3.14e-05*
Substrate	*2*	*8.80*	*4.40*	*1.1523*	*0.3201*

Table 28 Multiple comparisons of means of the Tukey test for EPT values, with site as factor. In italics are highlighted significant values for $p < 0.05$.

	diff.	lwr	upr	p adj.
ADS3-ADS2	-0.1118881	-1.211632	0.9878557	0.9682285
ADS6-ADS2	*-2.0209790*	*-3.120723*	*-0.9212352*	*0.0000890*
ADS6-ADS3	*-1.9090909*	*-3.053741*	*-0.7644413*	*0.0003986*

Actually no significant differences appear to exist between EPT values found on different substrates in three Adda sites (Table 27), although *microlithal* substrate shows EPT values slightly lower than *mesolithal* (Figure 29). The stronger presence of *microlithal* substrates in site ADS6 could thus be one cause for the minor richness in benthic community for this site.

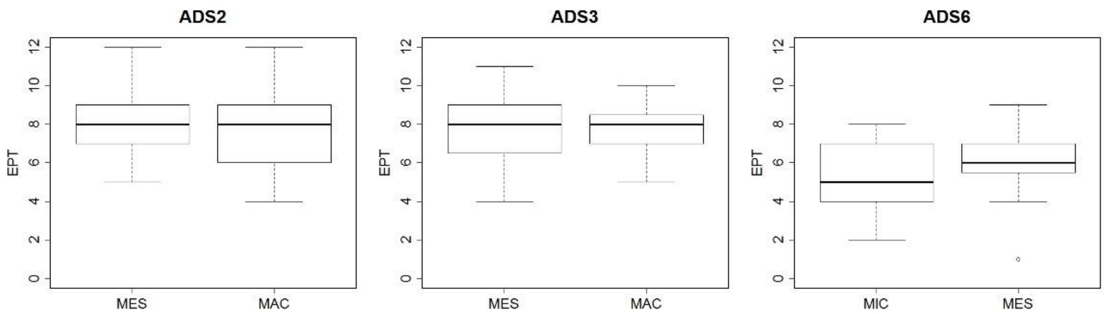


Figure 29 Box and whiskers plots of the EPT values found on different substrate typologies in three Adda sites (MAC = *macrolithal*, MES = *mesolithal*, MIC = *microlithal*).

Moreover, neither abundances significantly varies between substrates (Figure 30).

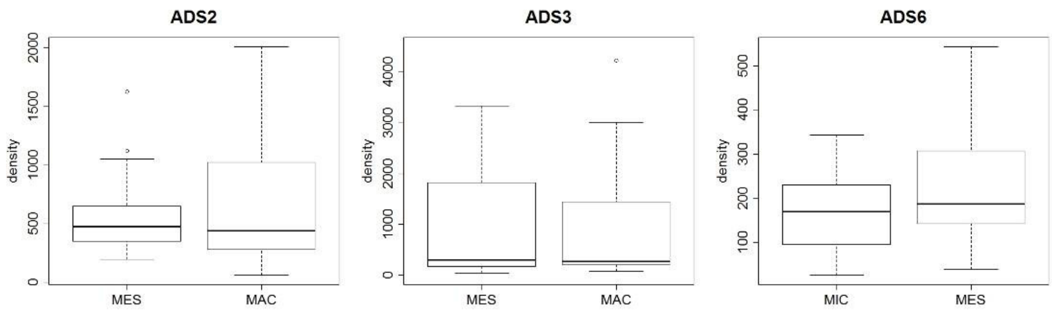


Figure 30 Box and whiskers plots of the density values (n° individuals / $0.05m^2$) found on different substrate typologies in three Adda sites (MAC = *macrolithal*, MES = *mesolithal*, MIC = *microlithal*).

These results bring to a first methodological observation: since it appears to exist only slight difference between communities sampled on different substrates, potential errors or differences between operators in the definition of the percentages of each substrate typology in the river reach (and the consequent identification of the number of replicates necessary for each typology) should produce no effects on total community definition.

Moreover, on the basis of these results, other factors than substrate type appear to influence benthic communities richness in EPT families; these factors could also differentiate communities between sites.

In order to understand if hydraulic parameters, which are of primary interest for the present study, could have a role in differentiating benthic communities between replicates, they were related to the community structures.

Plotting EPT values in relation to the key flow parameters, neither correlation nor structure in the data can be demonstrated. Instead some kind of structures can be seen plotting density (chosen as representative of PC2 in previous PCAs) against hydraulic parameters (Figure 31).

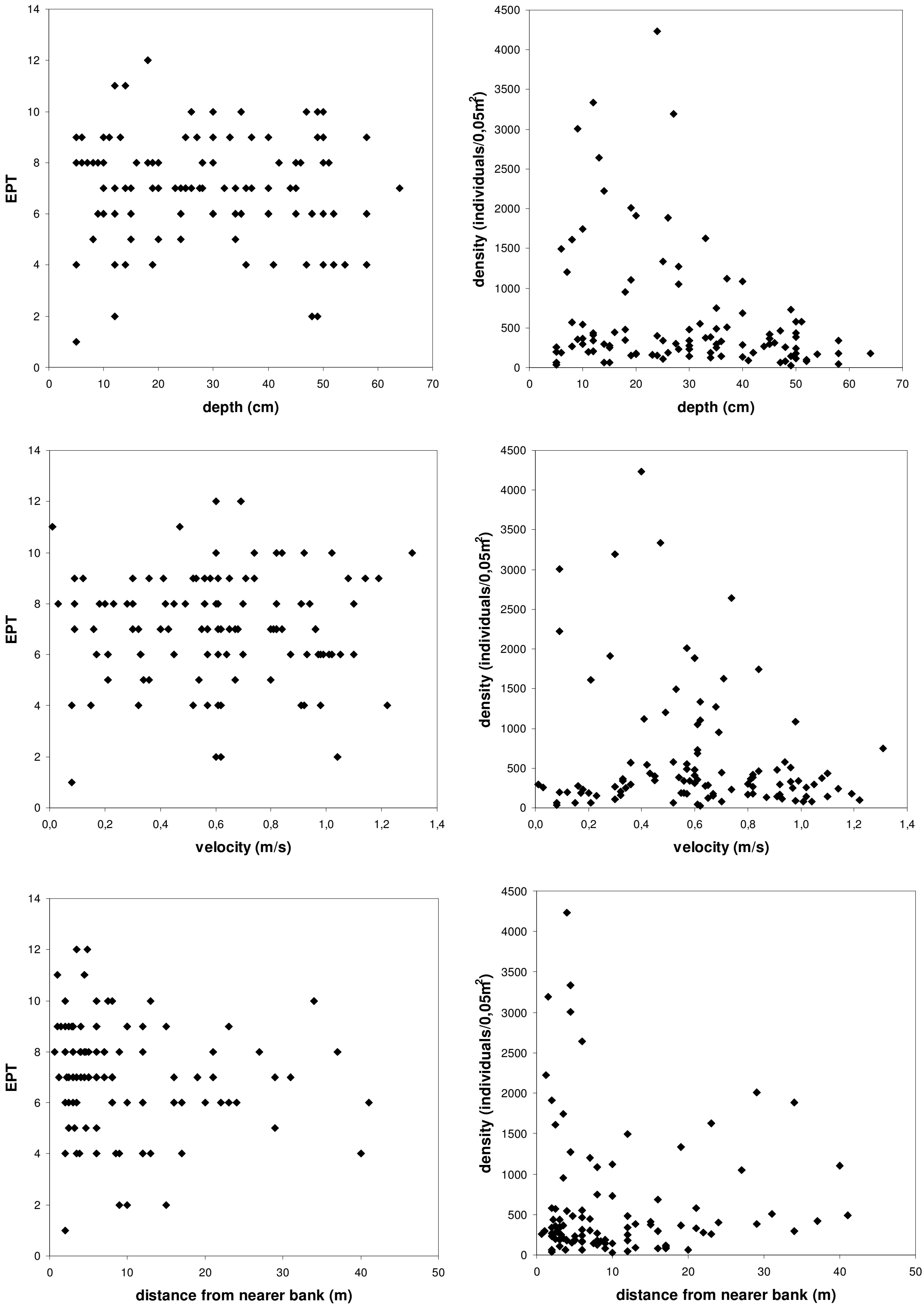


Figure 31 EPT (number of families belonging to Ephemeroptera, Plecoptera and Trichoptera) values and density of individuals found at different hydraulic conditions (depth, velocity and distance from nearer bank of points were subsamples were collected).

This linkage between density and hydraulic conditions could be partly an effect of the difficulty of sampling into deep, fast flowing waters.

However, many authors already highlighted the importance of hydraulic factors in controlling local macroinvertebrate abundance in macroinvetebrate community; e.g. Brooks *et al*. (2005) revealed how velocity (which they found to be the most important hydraulic variable), acts negatively on abundance and *taxa* richness.

The absence of linkage between EPT and hydraulic parameters, instead, let think that hydraulics act on densities without acting on *taxa* richness. This could happen either with density increasing in the same extent for each family or with density increasing for some particular families more than for the others. Since GOLD is, among the used richness/diversity metrics, the only one having some kind of correlation with PC2 ($R^2_{GOLD\text{-}PC2} = 0.50$), GOLD families appeared to be the best descriptor of the total density variation. In particular Chironomidae, which is one of the most represented families in the studied communities (with dominance in 69% of cases, Table 29), is responsible for a huge amount of the variation in total density. Indeed, Chironomidae abundance shows similar patterns of distribution for hydraulic factors as total density (Figure 32).

Table 29 Dominant macroinvertebrate families found in Adda sites and associated hydraulic parameters.

Site	Dominant family	N° of cases (subsamples)	Depth (cm) MEAN±SD	Velocity (m/s) MEAN±SD	Distance from nearer bank (m) MEAN±SD
ADS2	Bythiniidae	1	18.0	0.7	3.5
	Chironomidae	16	23.4 ± 12.9	0.5 ± 0.2	16.3 ± 9.2
	Elminthidae	2	8.5 ± 3.5	0.2 ± 0.1	3.5 ± 0.6
	Hydropsychidae	15	38.1 ± 11.1	0.8 ± 0.2	22.5 ± 12.2
	Hydroptylidae	1	19.0	0.2	4.7
	Neritidae	1	25.0	0.6	3.0
	Simuliidae	3	29.7 ± 17.6	0.8 ± 0.5	6.5 ± 2.6
ADS3	Ancylidae	2	32.5 ± 10.6	0.5 ± 0.2	2.9 ± 0.1
	Baetidae	2	50.0 ± 0.0	1.0 ± 0.2	8.0 ± 7.1
	Chironomidae	22	25.3 ± 16.0	0.5 ± 0.3	6.1 ± 5.1
	Hydropsychidae	6	38.0 ± 17.9	0.8 ± 0.3	4.5 ± 4.1
	Simuliidae	1	50.0	0.6	12.0
ADS6	Baetidae	1	49.0	0.6	10.0
	Chironomidae	28	27.4 ± 16.7	0.6 ± 0.3	6.3 ± 4.3
	Ephemerellidae	3	31.0 ± 16.1	0.7 ± 0.3	5.2 ± 2.3
	Naididae	1	54.0	0.9	8.5

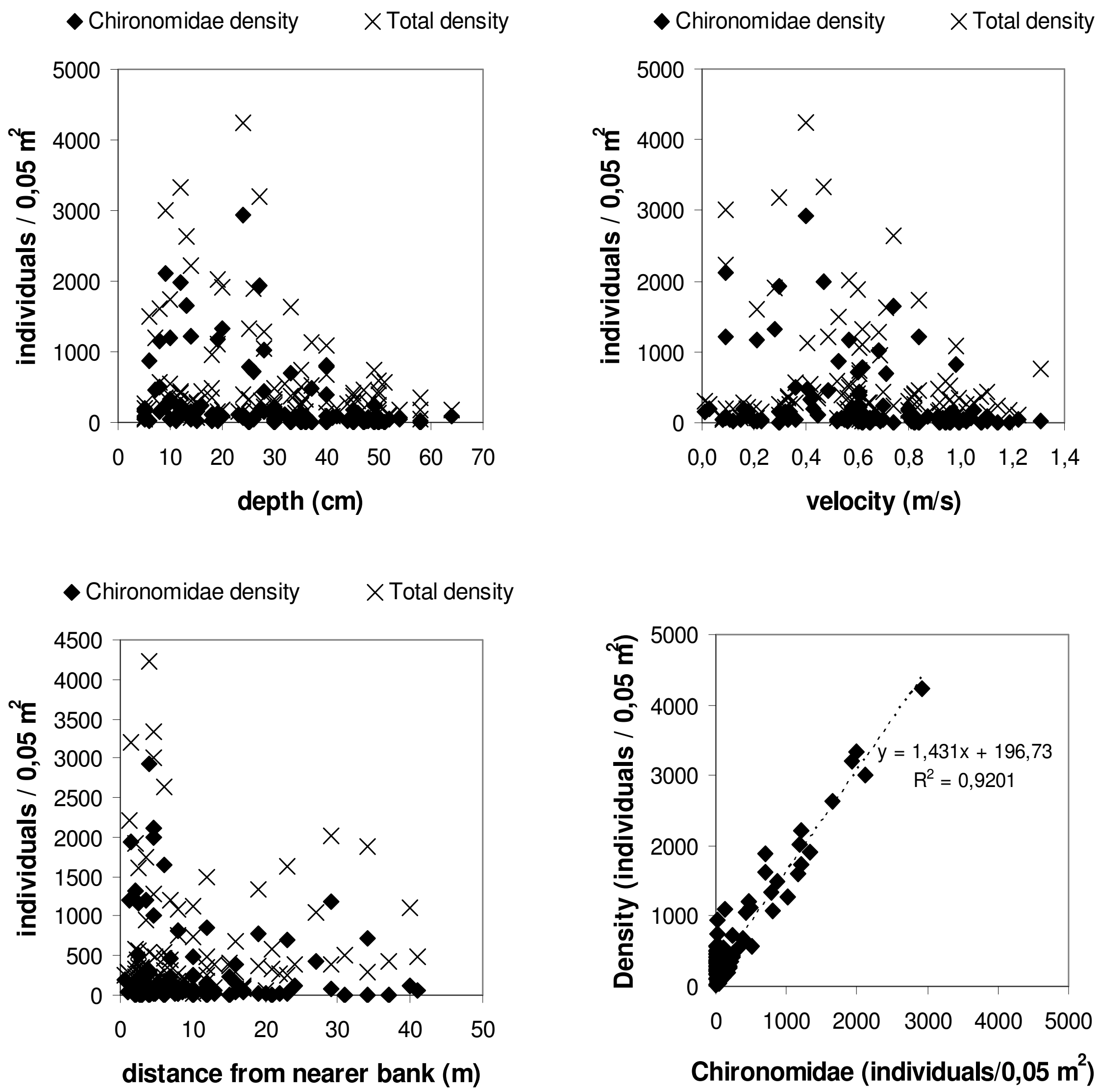


Figure 32 Density of individuals of Chironomidae found at different hydraulic conditions (depth, velocity and distance from nearer bank of points were subsamples were collected) and correlation between total and chironomids density.

Previous figures show how density reaches highest values approximately between 5 and 30 cm depth, and for current velocities lower than 0.8 m/s. These values result in general agreement with many published studies, which individuated a macroinvertebrate preference for intermediate to low values of depth and velocity, and highlighted how these parameters act both on total abundance (e.g. Degani *et* al., 1993: current preferences between 0.05 and 1.2 m/s, depth preference between 5 and 60cm; Brooks et al., 2005: sharp decrease between 0.2 and 0.5 m/s), diversity (e.g. Gore *et* al., 2001: current preferences between 0.2 and 0.4 m/s, depth preference between 20 and 30cm) and chironomids density (e.g. Jowett *et* al, 1991: mean current preference 0.6 m/s and mean depth preference 39 cm).

From these data, low flow conditions, which minimize disturbance on aquatic communities, appear to positively act on density. In effect, a positive relation between environmental (flow) stability and macroinvertebrate density, as well as *taxa* richness, was suggested by Death & Winterbourn (1995). As highlighted by the Authors, and in accordance to intermediate disturbance hypothesis, environmental stability along with a habitat patchiness are able to enhance diversity, as well as richness (Townsend *et al.*, 1997), so that sites characterised by prolonged minimum flow periods (i.e. environmental temporal stability) and morphological integrity (i.e. habitat patchiness), show enhanced macroinvertebrate diversity and taxonomic richness.

Even if from our data on the *taxa* richness the response to local flow characteristics was not detectable, probably because of a limited variability of the studied physical parameters in Adda sites, a general variation of diversity and richness between sites is visible at sample instead of subsample level: high richness was found for example in site ADS2, as shown in Figure 18, which is one of those with more prolonged minimum flow periods, but in a context of good environmental (morphological and chemical) integrity.

Therefore, even if in extended geographical contexts (e.g. considering a wide range of flow variation, from lowland to mountain waterbodies) some kind of diversity/richness response to hydraulic local parameters was found, this should not be interpreted as a good effect of the altered flow, since river environmental stability would come from hydrological conditions that are far away from natural ones.

Finally, presence of periphyton (i.e. macroalgae or mosses) on river substrate appeared to positively act on macroinvertebrate density, while it had no effects on EPT (Figure 33). Increase in macroinvertebrate density could hence be also an indirect effect of minimum flows maintenance, because of favoured algal growth with low flows (Biggs., 1996; and previously presented data).

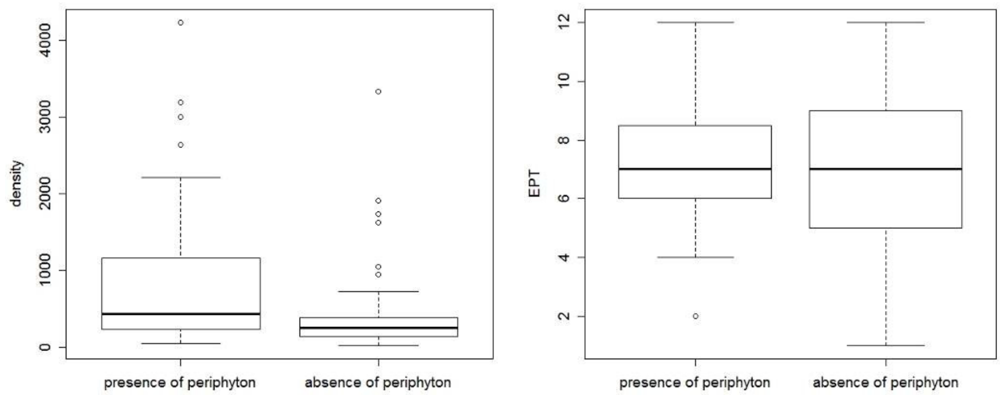


Figure 33 Box and whiskers plots of the density and EPT values found on replicates characterised by presence or absence of periphyton (i.e. macroalgae or mosses).

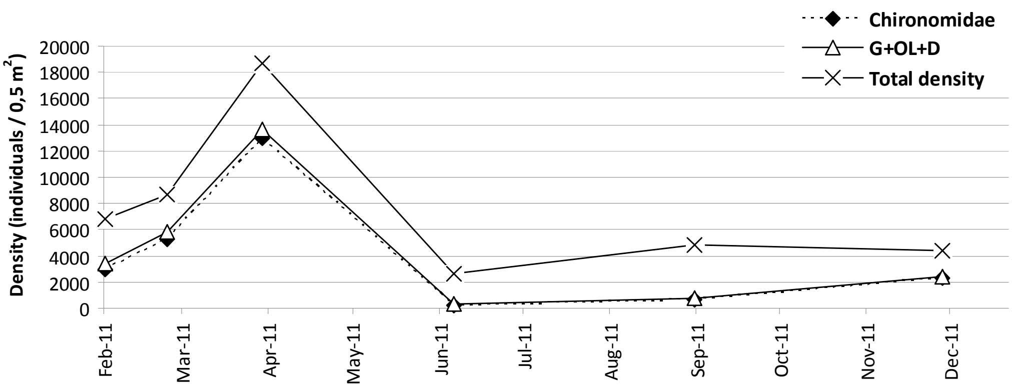
These results, besides of giving indications about possible connections between alteration of benthic communities and altered flowing conditions, bring to an important consideration: the simplistic use of diversity and richness metrics as indexes of “good ecological quality” appears to be useless for the detection of minimum flows effects on the aquatic communities.

For the next paragraph, density (or for simplicity chironomids density) will be thus used to study the effect of minimum flow duration on benthic community.

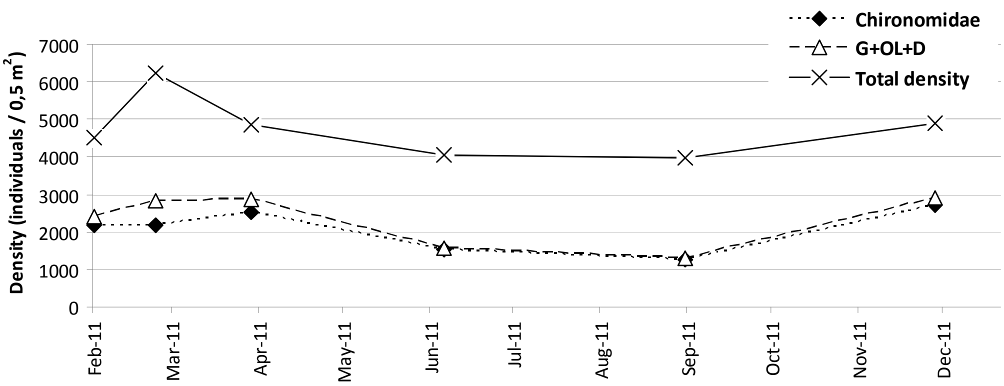
1.1.9 Influence of minimum flow duration on benthic macroinvertebrate communities

Density of individuals, paricularly those belonging to GOLD families (and particularly to chironomids) resulted, from previous analysis, to be the best descriptor of community changes in response to the variation of hydraulic parameters.

Total individual density in Ticino river strongly varied during the year (Figure 34), showing maximum values during early spring (in March in TIC1, in April in TIC4) and a minimum in late spring (June). GOLD and chironimids density presented a similar trend, althought in TIC4 total density maximum (in March) did not coincide with chironomids maximum (in April). Moreover TIC4 showed a narrower range of values and lower maxima than TIC1, with high values also in december. This differences could partly be caused by the stabler environment in TIC4, which is characterissed by a longer duration of low flows; however precise data about flow in TIC4 are missing, so a numeric analysis of the response of benthic community to minimum flow duration will be applied only for TIC1.



(a)



(b)

Figure 34 Trends in total maroinvertebrate density and GOLD families density in Ticino sites (TIC1 and TIC4) during 2011.

Mean values of density in different subsamples showed similar temporal trends to the one produced by using total samples, although samples collected in moments characterized by higher densities were also characterized by a wider range of densities between subsamples (Figure 35). This local high variability, particularly visible in March and April, could be connected with asyncronous life cycles between individuals, that generate a local patchiness in larval density.

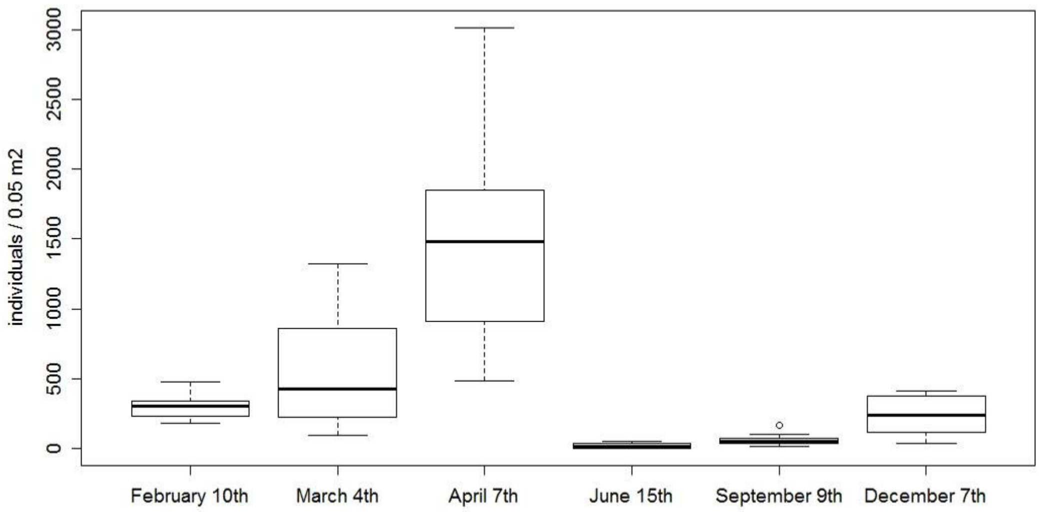


Figure 35 Box and whiskers plots of Chironomidae density in Ticino (site TIC1) during 2011.

In order to understand if the outlined trend in macroinvertebarte densities had some kind of connection with minimum flows duration, a "low flow index" was calculated by dividing the number of days of minimum flow preceding the sampling by the minimum flow value (since minimum flow value changes during the year, see Chapter 2.2).

This was possible for all of the data because samples were always collected in minimum flow days.

Low flow index showed a trend that is partially divergent to the one of macroinvertebrate densities, with inverted minima and maxima (Figure 36).

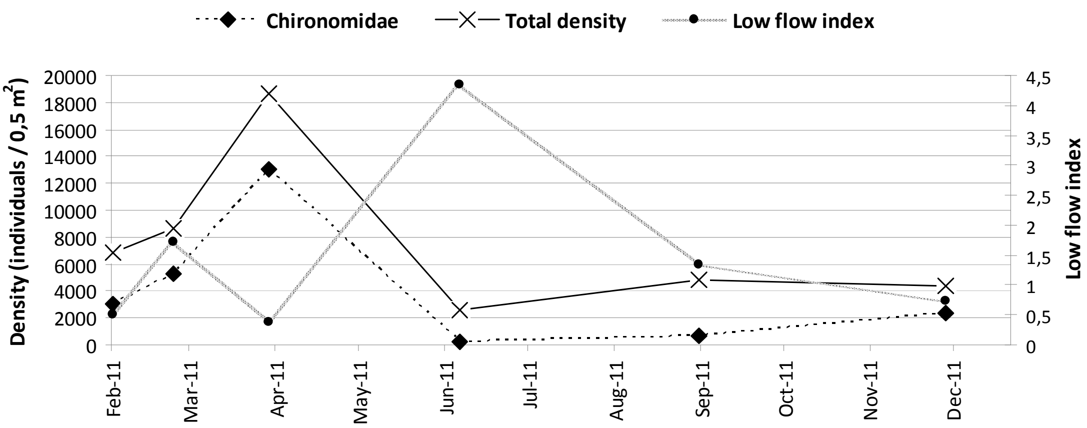


Figure 36 Trends in total maroinvertebrate density, GOLD families density in Ticino sites (TIC1 and TIC4) during 2011, compared with a low flow index (n° of days of m.f. preceding sampling / m.f. value).

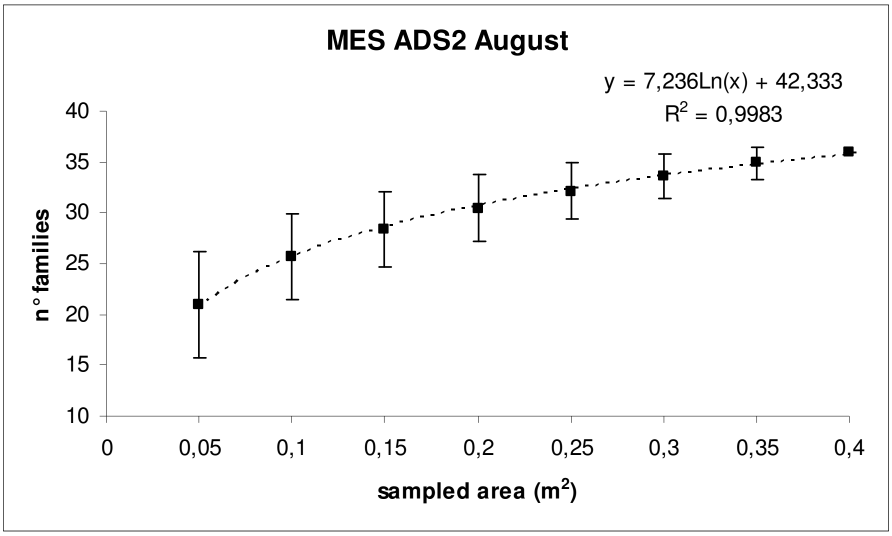
This could lead to the idea that density is favoured by high flows. However the incresing density between February and March, within a prolonged period of minimum flow (see also Figure 7) let us think that early spring increase is related to seasonality in species life cycles. Macroinvertebrate density trend is indeed influenced by seasonallity and consequent species life history. Strong increase in total density in early spring and a decrease in late spring, evident in our data, could hence be related to larval development and consequent emergeing, eventually besides of any antropogenic perturbation. A strongly similar trend can also be seen in GOLD families densitiy.

As a confirmation of the hypothesys that seasonality has a stronger influence on shaping density curve than flow, is the fact that 2011 was an hydrologically unusual year for Ticino, since in May and June there was a long period of low flow instead of the usual spring high flows. Dispite this, the density curve followed the usual trend for Italian rivers (with chironomids emerging from spring to late summer; Nocentini A, 1985; Boerger, 1981; Oliver, 1971).

Despite seasonallity appeared to be the stronger driving force for community density, smaller range of density variation in a site with longer periods of low flows (TIC4 than TIC1) suggests that, in smaller extent, prolonged low flows could have an influence on benthic macroinvertebrates. Prolonged low flows indeed create a too strong environmental stability, which is particularly visible in a site located in a reach with a very wide channel and a branched structure, which, combined with low flows, leads to very low water depht and locally very low current velocities. This consideration indicates how also density (and not only diversity) can increase with intermediate disturbance (i.e. in TIC1).

1.1.10 Minimum sampling area definition

The mean number of families increases with the sampled area (being of 0.05 m^2 per subsample) following logarithmic curves, which fit very well each of the point sets (see as examples the graphs in Figure 37).



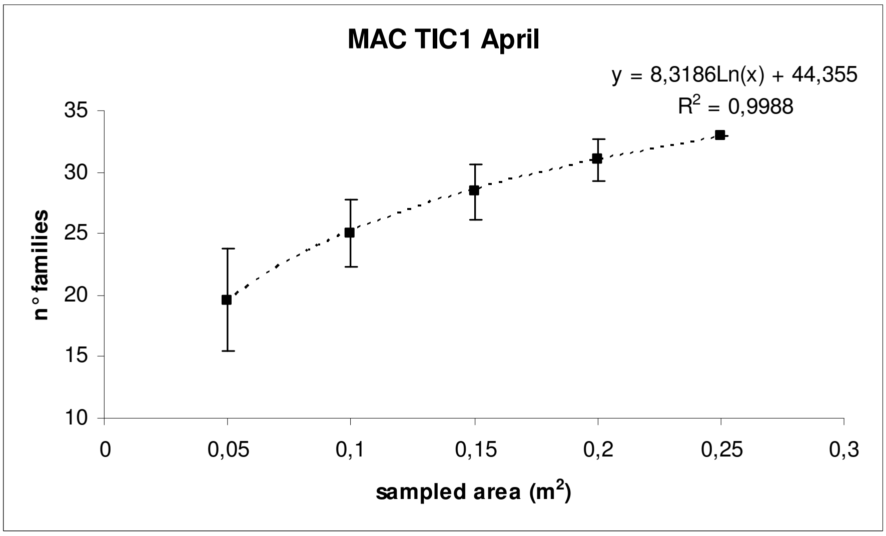


Figure 37 Examples of family – area discovery curves and fitting natural logaritmic curves, for two samples collected in Adda and Ticino. Points represent mean number of families per area, calculated as described in Chapter 1.1.3.

This trend means that if cumulative areas were ideally sampled till infinite, new families discovering would indefinitely continue, since lognormal curves does not reach an horizontal asymptote. To solve the problem of identifying the maximum reachable number of families, a limit area of 1 m^2 was chosen, considering that a sample collected in a wider area is not worth the effort. This number is nevertheless big, in comparison with the sampling area indicated by the Italian sampling protocol

(Buffagni & Erba, 2007), which states that total area to be sampled (deriving from the sum of all of the different substrates typologies, and not for a single substrate) should be of 0.5 m^2 for lowland rivers.
Mean percentage differences between *taxa* richness (number of families) collected in partial sampled areas and number of families sampled on an area of 1 m^2 (calculated trough logarithmic regression) are represented in Figure 38. As it can be seen, this difference is near 25% for a sampled area of 0.25 m^2 (corresponding to 5 replicates, the minimum number sampled for this study). Difference among 0.25 m^2 and 0.5 m^2 (area required by protocols for samplings in lowland rivers) was indeed near 15%. Difference in number of families between the sampled area and the maximum sample area of 1 m^2 do not show correlation with sample richness and do not strongly differ among the three different substrates. Therefore these difference values can be assumed as quite precise methodological errors in defining macroinvertebrate fauna richness.

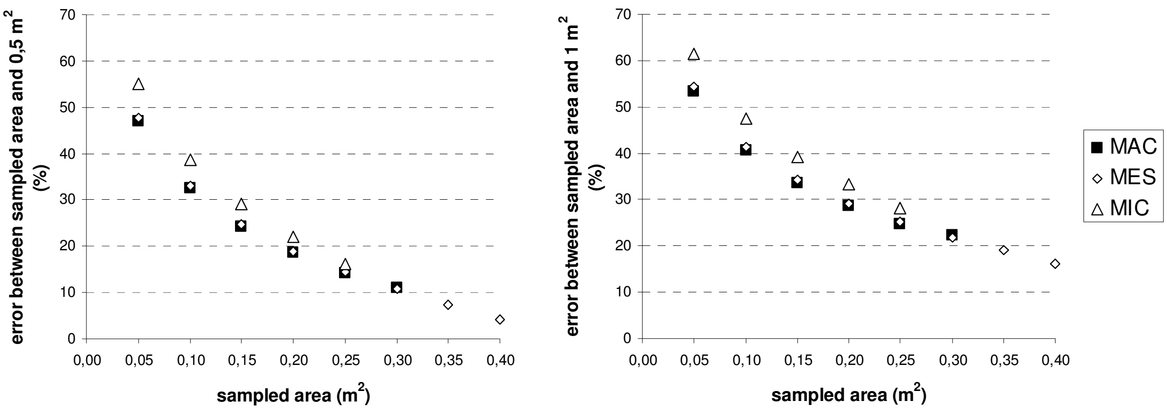


Figure 38 Mean percentage difference in number of families between sampled area and maximum sampled area (0.5 or 1 m^2).

Besides the cause of local differences in *taxa* richness, these results reveal that a sample collected on at least 0.4 m^2 (8 replicates) generates a margin of error of nearly 15% ($\Delta_{1m2-0.4m2}$) on the definition of the community richness, which could be considered acceptable. Since from previous analysis appeared that there are no strong differences between communities present on MAC and MES substrates (see Chapter 1.1.8), these minimum area should be reached summing up MAC and MES subsamples; while for sites where also MIC is sampled the minimum area should be reached separately both by MIC and MES (so with a total area of at least 0.8 m^2), since MIC communities resulted different from those of the other two substrate typologies.
Thus, by applying standard sampling method, that assumes a proportional number of replicates with different substrate cover percentages, samples collected in sites characterised by the presence of small percentages of some substrate typologies (that will be associated to few replicates) suffer from the risk of high errors in the determination of a realistic community structure. This could eventually have an effect also on consequent considerations and on biological status definition.

4.4 Functional approach

In this chapter data collected with the open channel method applied on Ticino river during 2010, 2011 and 2012 are presented. Since each river system has particular functional characteristics, measures taken during the first year (2010) were useful as a first characterization of the daily cycles of the considered parameters in Ticino. These data were collected in sections *Mazzini* and *Porto* during spring and summer.

Collected data for the selected parameters show a strong seasonal variation, as represented in Figure 39.

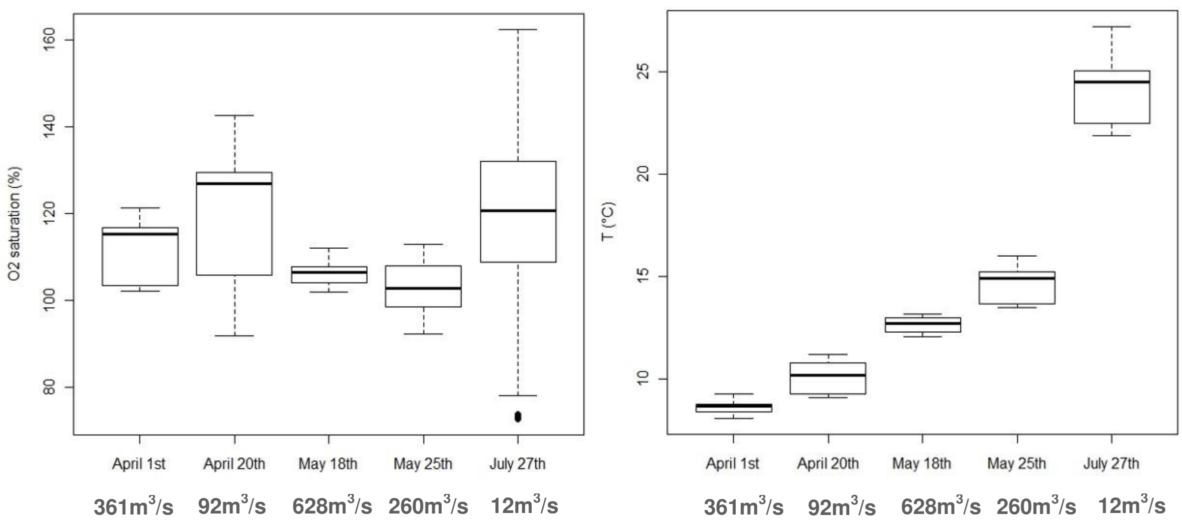


Figure 39 Dissolved oxygen and water temperature variability during spring and summer 2010 in Ticino river.

Even if seasonality has a strong influence on data, the maximum range of variability in days with lower flows (April 20^{th} and July 27^{th}) let suppose that flow play a pivotal role in regulating such a variation.

Indeed, from data collected during the entire study period (2010-2012) in the same reach, appeared that nitric nitrogen and electrical conductivity are positively correlated with flow, while BOD_5 concentrations are higher during low flows (Figure 40). First year measurements allowed to select, among the analysed ones, useful and measurable (in the range of instrumental measure limits) macropollutants.

First year measurements were also useful to identify patterns in oxygen daily cycles, as already discussed by Odum (1956). Minimum and maximum oxygen values were detected respectively at the end of the night (*pre-dawn* measures) and during afternoon. Maximum upstream-downstream variation were observed during morning (increase in oxygen concentration) and evening (decrease in oxygen concentration) (Figure 41). Similar patterns of variations are followed by water temperature and pH.

These considerations were useful for planning measures in 2011 and 2012. Amplitude and pattern of daily variation of oxygen, temperature and pH allow to get to a methodological conclusion, particularly useful for monitoring the river status: measures taken during morning indicate intermediate conditions and so are the most representative of general site conditions.

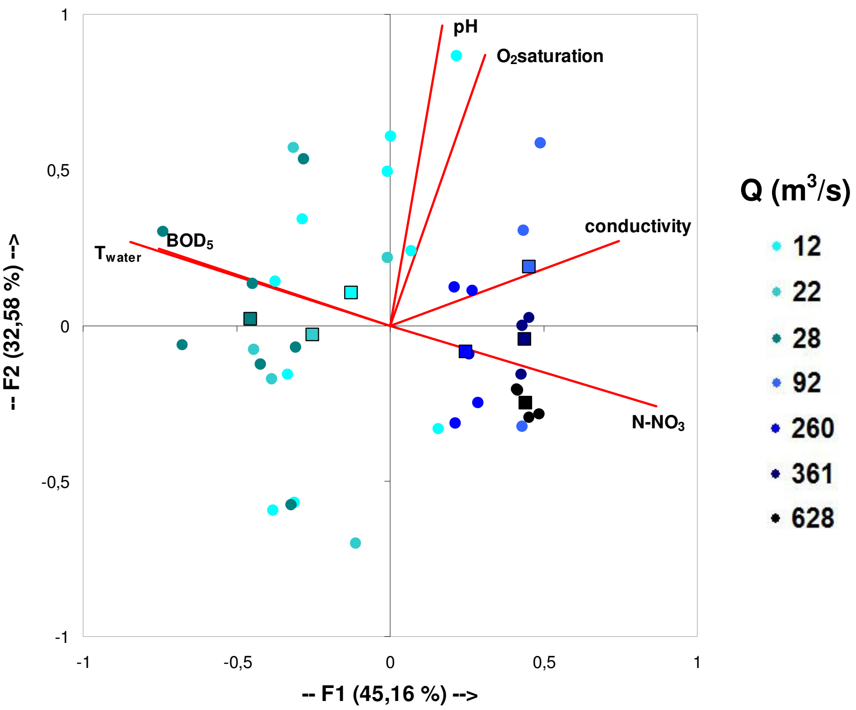


Figure 40 Plot of the Principal Component analysis (PCA) of chemical and physical parameters in Ticino river (*Mazzini-Porto* reach) during 2010, 2011 and 2012.

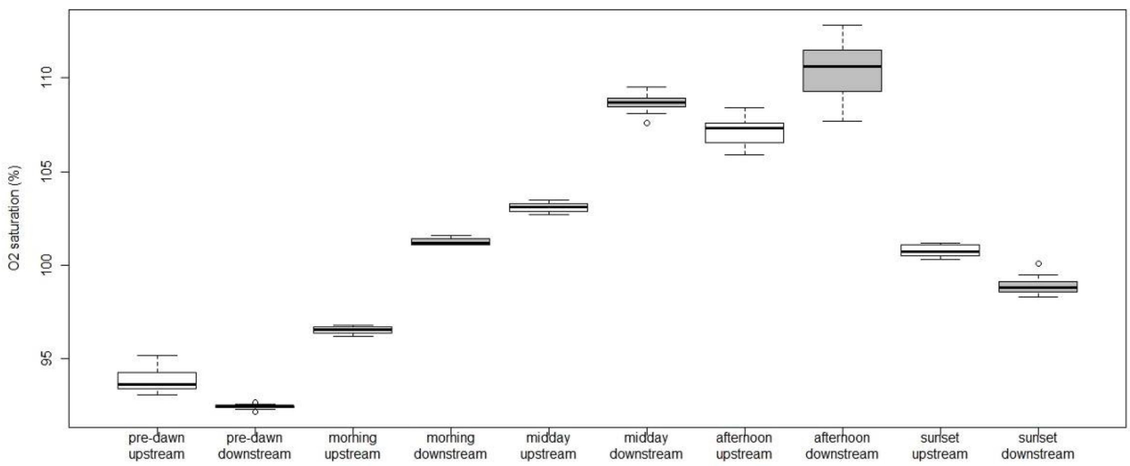


Figure 41 Daily cycle of dissolved oxygen in Ticino river in *Mazzini* (upstream) and *Porto* (downstream) sites, in May 25th 2010.

1.1.11 Influence of flow on oxygen and temperature daily cycles

Water temperature showed daily cycles with highest values during afternoon and lowest values at the end of the night.

During summer, afternoon temperatures reached high values, up to 27.7°C, measured on 22 August 2012 at Mazzini site at 17.20.

Interestingly, difference between air maximum temperature and water maximum temperature is higher in days with higher minimum flows, than in near days with lower minimum flows, with comparable meteorological conditions (Table 30). Higher minimum flow values therefore appeared to have a mitigating function on highest summer temperatures.

Table 30 Comparison between air and water temperature in couples of near and meteorologically comparable days.

Date	Minimum flow value (m^3/s)	$\Delta Tmax_{air-water}$
August 18th	28	6.8
August 19th	12	4.5
August 31st	12	1.6
September 1st	22	3.2
August 22nd	28	7.4
August 24th	22	4.5

Temperature optima for principal fish species present in Ticino river are generally indicated under 27°C by many authors (as reviewed by Tissot & Souchon, 2010), and optima for juvenile stadia are generally lower than for adults. Since period of reproduction for those species varies between February and July (Zerunian, 2004), larval and juvenile stadia can actually experience temperatures at the upper limit of their optimal range.

Therefore high water temperatures during summertime can have a negative effect on populations fitness, since they reach higher values than their optima. This thermal alteration is more relevant for species which spawn later, such as Telestes (*Leuciscus souffia multicellus*), for which 27°C is defined as maximum tolerable temperature by Ginot et al. (1996).

During the summer days temperature never underwent 21°C, also at the end of the night.

We remind that Wels Catfish (*Silurus glanis*), which is a strongly invasive species in Italy, has temperature optima generally higher than autochthons, which could further enhance its fitness in conditions of low flow. Hence, inadequate minimum flows could act on fish community structure, even though this is difficultly detectable by studying fish community with the criteria provided for WFD. Indeed fishes are subject to many other alteration factors which give more visible effects (absence of longitudinal continuity due to wires, fishing, …) and determining limiting factor for fish populations is often difficult.

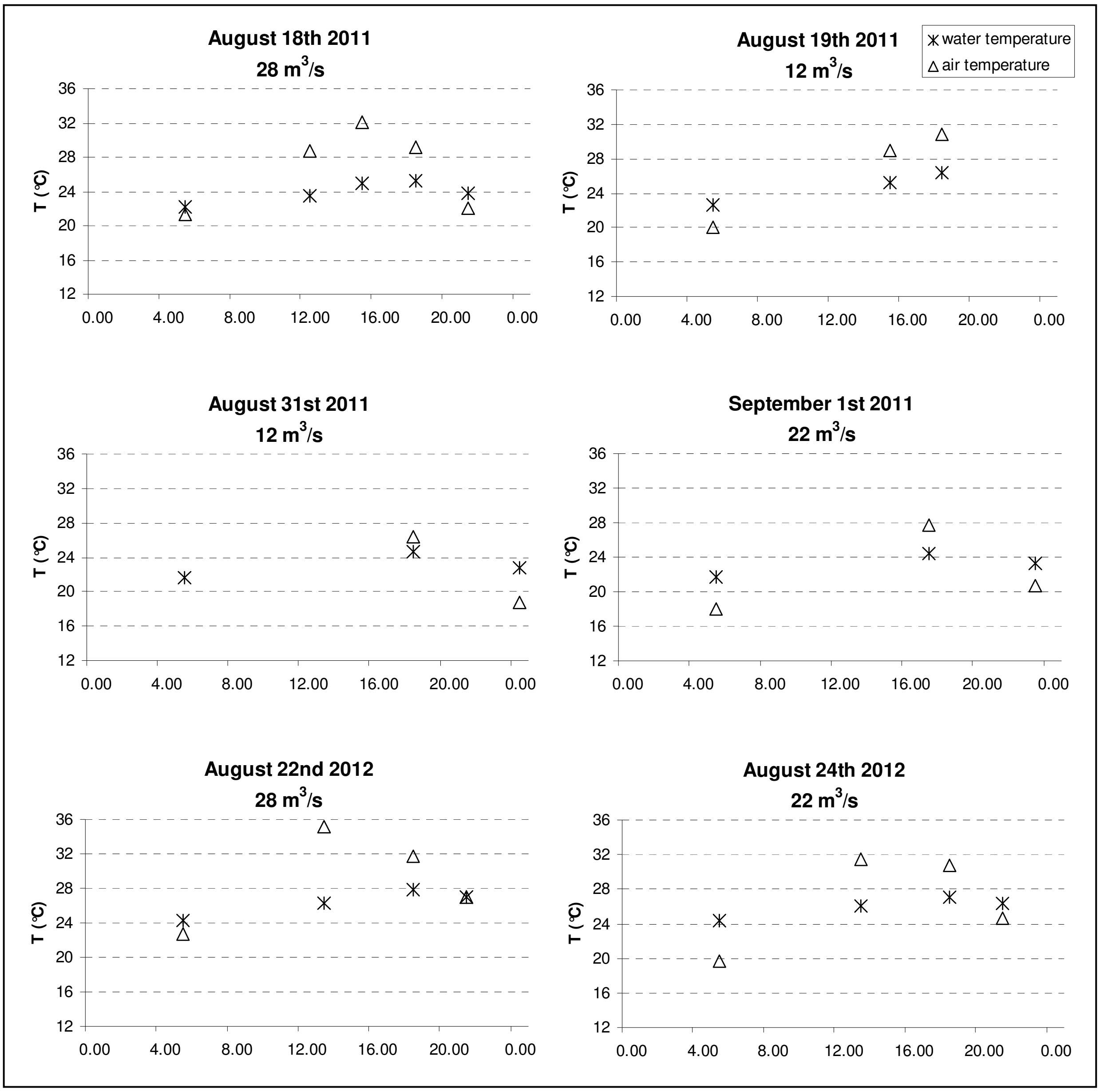


Figure 42 Daily cycles of water (star) and air (triangle) temperature in Ticino river (site: Porto) in near days with different minimum flow values (median temperature values).

Dissolved oxygen showed daily cycles with temporal patterns similar to those of water temperature. The values, at a local scale, did not strongly differ among near days characterised by different values of minimum flows (Figure 43). Differences in oxygen metabolism (at a reach scale) among different days are investigated and discussed in the next Chapter.

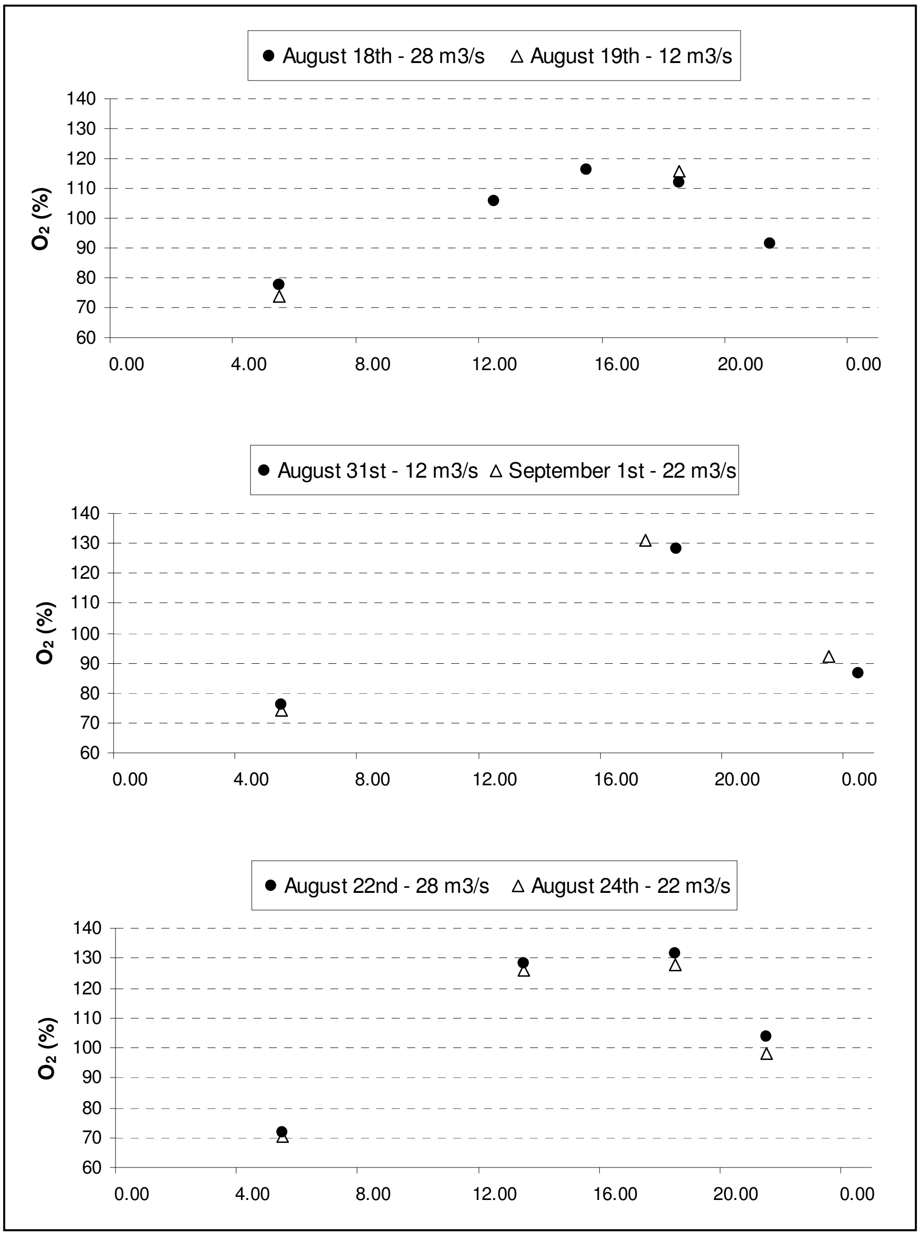


Figure 43 Daily cycles of oxygen saturation in Ticino river (site: Porto) in near days with different minimum flow values (median oxygen values).

1.1.12 Influence of flow on fluvial metabolism

Data about ecosystem gross primary production (P), respiration (R) and their ratio (P/R), calculated through the open-channel method between sites *Mazzini* and *Porto*, are represented in Table 31.

Presented data enabled us to get to some methodological considerations:

- days for which only few (< 3) measures were available led to very low P values, probably related to too high day-cycle approximation. Values about those days (August 19th, 22nd and 24th) were rejected and not considered in the following dissertation;
- for the days in which oxygen measure relative to *pre-dawn* period partially covered the lighted period (e.g. upstream station measured during night, downstream station measured near sunrise), it was not possible to correctly determine R (indeed it appeared to be a negative value). Values about those days (April 20th) were rejected and not considered in the following dissertation too.

Table 31 Data about gross primary production (P), respiration (R) and production/respiration ratio (P/R) of Ticino river, calculated through the *open-channel method*. Data considered during the dissertation are in bold.

Year	date	Q (m^3/s)	P ($g/m^2/day$)	R ($g/m^2/day$)	P/R
2010	**April 1st**	**361**	**5,4**	**4,5**	**1,2**
2010	April 20th	92	7,3	-1,8	-4,0
2010	**May 18th**	**628**	**2,9**	**18,0**	**0,2**
2010	**May 25th**	**260**	**14,5**	**9,6**	**1,5**
2010	**July 27th**	**12**	**5,0**	**4,0**	**1,2**
2011	**August 18th**	**28**	**11,8**	**12,0**	**1,0**
2011	August 19th	12	$9{,}9 \cdot 10^{-5}$	-0,4	$-2{,}6 \cdot 10^{-4}$
2011	**August 31st**	**12**	**43,2**	**18,9**	**2,3**
2011	**September 1st**	**22**	**12,5**	**16,0**	**0,8**
2012	August 22nd	28	-0,1	16,5	$-5{,}4 \cdot 10^{-3}$
2012	August 24th	22	$1{,}4 \cdot 10^{-3}$	12,6	$1{,}1 \cdot 10^{-4}$

Gross primary production in Ticino river covered a wide range of values, between 3 $g/m^2/day$ and 43 $g/m^2/day$. Respiration showed less variability than primary production (MEAN±SD respectively 11.9 ± 6.1 and 13.6 ± 13.7). The latter, instead, had generally higher values in summer than in spring. This could be related to primary producers development with vegetative season proceeding, but also with diminishing flows. Indeed, higher P values were detected also in days with low minimum flows, compared with near days with higher (even if minimum) flows (August 31st vs September 1st).

Since R was less variable, higher P during summer days with low flows involved increase in P/R value (Figure 44).

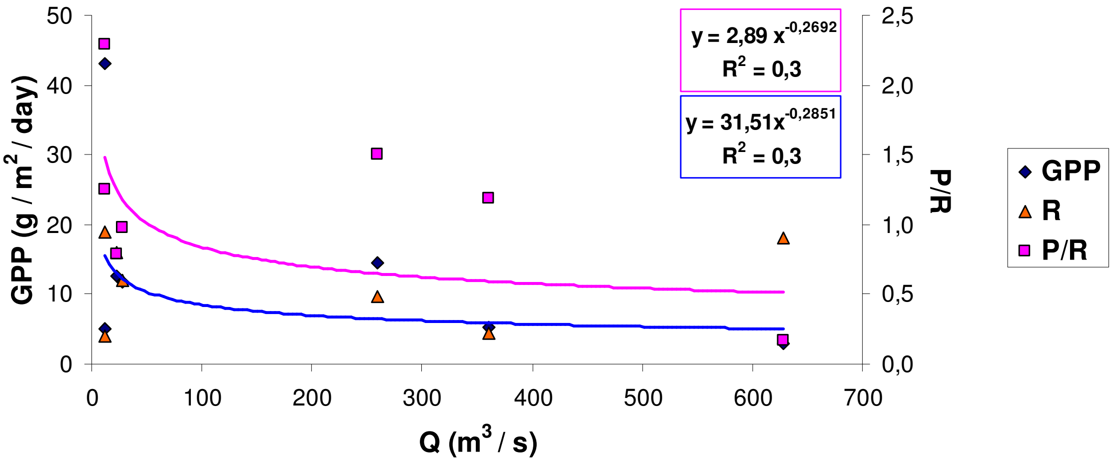


Figure 44 Gross primary production (GPP), respiration (R) and production/respiration ratio (P/R) trends with different flow values.

Looking at P/R ratios, the river reach resulted to be almost always in a range of autotrophy (P/R > 1), as it was expected to be, since it is an intermediate reach in the entire watercourse (Vannote *et al.*, 1980). P/R value underwent 1 only in two cases: in May 18th and September 1st.

In the first case a possible explanation is the extremely high flow (628 m^3/s), which probably determined river bed movement and consequent strong reduction in P, as already found in many other studies (e.g. Uehlinger *et al*., 2003). Moreover, a mean water depth of 2.6m made the studied reach in those flow conditions more similar to the terminal part of a river (potamon).

In the case of September 1st, P has intermediate values but R is higher. Considering that P/R is just slightly lower than 1 (0.8) and that September 1st is the latest measured summer day, I could suppose that, after a period of high production (in summer), plant community production went to a decrease with the end of the vegetative period, thus diminishing P/R.

A possible negative aspect of high P values during summer could indeed be aquatic plants disproportionate growth, and, at the end of the summer, the presence of a high amount of algal decaying biomass, which consumption could lead to a shift to an eterothophic status at the end of vegetative season. Algal abundant growth was indeed observed during summer in Ticino river, particularly related to *Cladophora*, *Spirogyra*, *Oedogonium* and *Hydrodyction* genera (see Chapter 1.1.6).

General autotrophy (P/R > 1) let us suppose that organic carbon produced by instream producers represents the principal food base of the ecosystem (Young *et al.*, 2008). Lower values of P during spring, however, drive P/R in the direction of an equilibrium; during this period eventual increase of organic matter incoming from surrounding terrestrial area could overbalance this ratio, shifting the ecosystem to an heterotrophic status. This could lead to dissolved oxygen consumption and consequent higher oxygen deficit; however, low water temperatures in spring could help maintaining high dissolved oxygen levels.

Deepening the study of fluvial metabolism considering seasons other than summer could open to interesting results for the interpretation of river functionality in response to flow, season and periphyton development.

Intra-seasonal (summer) variation of P, R and P/R appeared to be related to flow, with higher minimum flows diminishing all of the three parameters, even if a greater dataset is required to confirm this relation.

In order to classify the functionality of the Ticino river from a quality point of view, by using P, R and P/R, I applied the classification criteria proposed by Young *et al.* (2008). From this approach, the values calculated for Ticino river widely vary from healthy to poor level, with apparent no connection with flow (Table 32). However, values used by Young *et al.* (2008) for the definition of the levels were collected in pristine streams, which could be not representative of lowland rivers as Ticino. As previously discussed in Chapter 1.1.7, a major difficulty in defining biological and ecological status in lowland rivers is indeed in the absence of unperturbed sites to be used as a reference.

Table 32 Data about gross primary production (P), respiration (R) and production/respiration ratio (P/R) of Ticino river, and related river health level as from Young *et al.* (2008).

Year	date	Q (m^3/s)	P ($g/m^2/day$)	P level	R ($g/m^2/day$)	R level	P/R	P/R level
2010	April 1st	361	5,4	Satisfactory	4,5	Healthy	1,2	Satisfactory
2010	May 18th	628	2,9	Healthy	18,0	Poor	0,2	Healthy
2010	May 25th	260	14,5	Poor	9,6	Poor	1,5	Satisfactory
2011	August 18th	28	11,8	Poor	12,0	Poor	1,0	Satisfactory
2011	September 1st	22	12,5	Poor	16,0	Poor	0,8	Healthy
2010	July 27th	12	5,0	Satisfactory	4,0	Healthy	1,2	Satisfactory
2011	August 31st	12	43,2	Poor	18,9	Poor	2,3	Satisfactory
	Mean ± SD		**11.9 ± 6.1**	**Poor**	**13.6 ± 13.7**	**Poor**	**1.2 ± 0.7**	**Satisfactory**

All presented data are liable to uncertainties because of D_{in} value, which can vary in response to chosen calculating method. For example, in the present case, the attempt to calculate it through two different methods was made: McBride (2002) formula led to values that appeared unrealistic and strongly different from those calculated by using Odum formula; therefore the latter were used. Problems in applying Mc Bride formula in particular situations (e.g. in days with very log photoperiods) were already highlighted by the Author.

Another source of uncertainties lies in the definition of P value. For the present study daily primary production was calculated as the sum of defined integrals of straight segments between measures taken in different moments of the day. The use of a regression sine curve to approximate daily production was also tried. However simple sine regression, which Chapra and DiToro (1991) individuated to well describe production within the photoperiod (hence with a half sinusoid), does not fit well data about night. In order to avoid complex calculations (such as the application of Fourier series), I preferred to use simple interpolation of data with straight lines. This simplification allows an easy repeatability of the measuring scheme, with limited error linked to chosen regression type, given a minimum number of measures taken.

Presence of a riparian environment

During 2011 and 2012 data about physical and chemical parameters were measured also in a river reach located upstream the previous one and chosen because of the presence of a riparian wetted area, in connection with the main channel. Connection in presence of minimum flows was partial: water from the lateral environment flowed into the river, while river water did not superficially enter the lateral environment. This condition changed with higher flows and with very high flows riparian environment became a river branch.

During low to medium flows into the riparian environment rich macrophytes communities developed (Figure 45) and water temperatures remained low also in summer (nearly 15°C). Many juvenile fishes were seen.

Figure 45 Riparian environment studied on Ticino river.

Data about chemical and physical parameters collected in the river reach characterised by this riparian freshwater environment (first reach) were characterised by balances in BOD_5 and electrical conductivity values generally different from the other reach (second reach) (Figure 46(a)), while other parameters, like water temperature, oxygen concentration and pH, showed the same pattern of variation in the two reaches, being influenced principally by daily hour (Figure 46(b)).

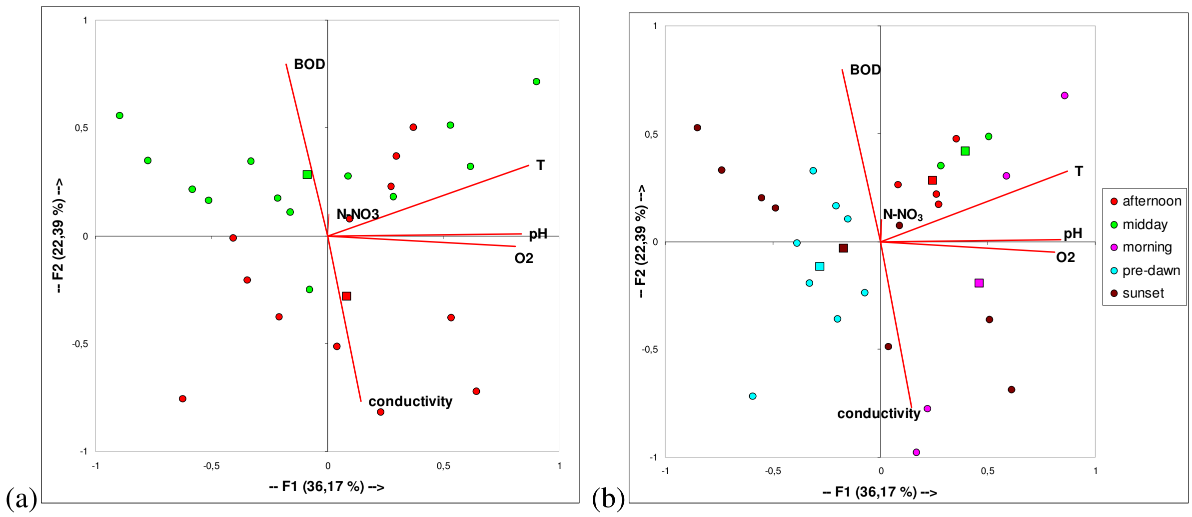


Figure 46 Plots of the Principal Component Analysis on physical and chemical data (mass balances – $\Delta g/m^2/h$) in the studied reaches. (a) red points = 2nd reach; green points = 1st reach; (b) different colours for different moments of the day.

BOD_5 areal loads decreased in both reaches, even if in the first reach ΔBOD_5 was minor than in the second one; this could be an effect of the presence of the lateral environment, which could act as a source of organic carbon and nutrients on the first river reach. Mass balances for nutrients showed an increase in their loads for the first reach, while in the second one we can see an abatement (Figure 47). The two reaches appeared hence to have a different behaviour in the nutrient and organic carbon processing, which could be related to the presence of the riparian environment in the first reach.

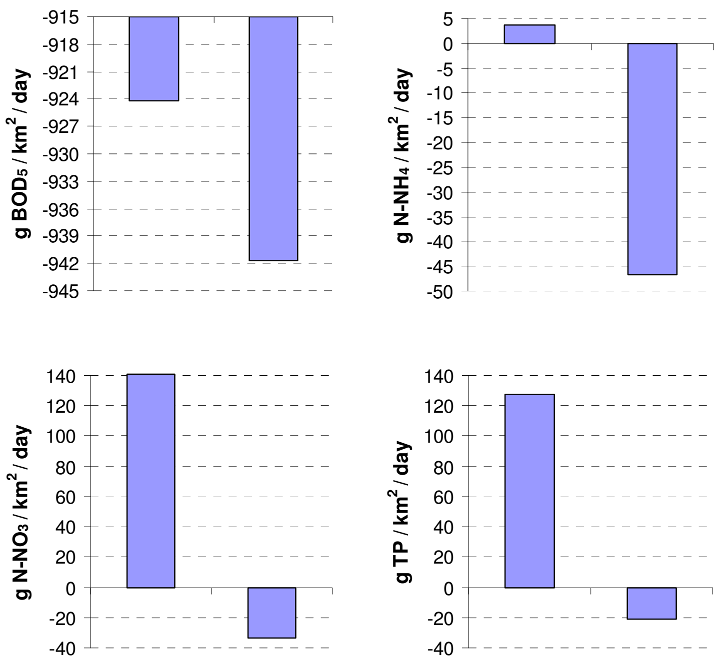


Figure 47 Mass balances of nutrients in the studied river reaches (1st reach = in connection with riparian environment; 2nd reach = without connection with riparian environments).

Presence of the riparian environment seems to act also on fluvial metabolism, since P and R values in the first reach were lower than in the second one, even if P/R was always higher than the unit and did not differ between days with different minimum flow values (Table 33). As for the second reach, with higher minimum flow, R and more than this P, are lower. However, in the first reach, P/R did not vary and metabolism remained autotrophic.

Table 33 Comparison of data about gross primary production (P), respiration (R) and production/respiration ratio (P/R) between the first (*Maddalena* - *Mazzini*) and the second (*Mazzini* - *Porto*) reaches defined on Ticino river.

Date	**Q (m^3/s)**	**Reach**	**P ($g/m^2/day$)**	**R ($g/m^2/day$)**	**P/R**
August 31st	12	Reach 1	21,7	16,3	1,3
		Reach 2	43,2	18,9	2,3
September 1st	22	Reach 1	12,2	9,6	1,3
		Reach 2	12,5	16,0	0,8

For the present study the effect of the lateral environment on fluvial chemistry was studied only during days characterised by low flows (minimum flows), while I did not investigate its behaviour in presence of higher flows. It could be particularly interesting to study the effects of flows which are capable of completely connecting the lateral environment with the main channel. Another interesting scenario to be studied would be during minimum flows, just after a period of high flow, to measure the effect of interruption of minimum flow periods (and hence partial isolation) on the lateral environment vitality. A comprehension in the effects of flood-pulse frequency and duration on ecosystem processes would be useful for the definition of minimum flow duration, besides of minimum flow volume.

4.5 Individualization of minimum flow values and “environmental sustainable flow schemes”

In previous chapters three different aspects of fluvial ecosystem were approached for the study of the ecological effects of the minimum flow volumes and for the individuation of environmental sustainable flow schemes: biological structures, ecosystem functionality and lateral connectivity. All of them are key components to be considered in the definition of environmental sustainable flow schemes and their protection must be among the aims of the application of minimum flows.
As resulted by presented data, all of the characteristics of minimum flows (entity, duration, frequency and timing and their combination) could act on ecosystem integrity and so they must be carefully evaluated.

From the present study benthic macroinvertebrates appeared to be poor indicators of hydrological alteration. Their use in instream habitat methods (like PHABSIM) should be very careful because conditions that maximise habitat preferences of benthic macroinvertebrates do not coincide with natural conditions, since, as already discussed, macroinvertebrates show preferences for low current velocity and low water depth (associated to altered flow conditions). The use of instream habitat methods, thus, should not create the environment with the highest percentage of preferred habitats; it should instead create an environment in which the natural patchiness of habitats is restored, eventually with reduction in habitat availability for macroinvertebrates. Moreover, it should be taken into account that values of water depth and current velocity corresponding to peak in organisms density cannot be considered as preference values, but only as habitat use indications, since the study was not conducted on a pristine system and therefore distribution of macroinvertebrate could be influenced by antropogenic factors, besides from their physical preferences. For example, with low flows, besides of an increase in favourable velocity and depth values, macroinvertebrate density could increase also as an effect of concentration due to reduced river bed amplitude, and this reduction could lead to increased competition and predation (Elosegi et al., 2010), also for their fish predators. Therefore
Those values should be confirmed as preference values by measuring them into reference sites where almost hydrological alteration is absent.

Another biotic component that was not specifically studied in this work, but could be useful as bioindicator of hydrological alteration, is periphyton. Its development is influenced by flow through bed movement, nutrient load and light availability (e.g. Biggs, 1996; Madsen *et al.*, 2001; Brooks *et al.*, 2005). An adjustment of sampling methods to accomplish this aspect should be useful and an attempt on Ticino river was already made, even if not presented in this study. Although it could be difficult to discriminate different values of minimum flows by studying periphyton, its development could be put in connection with low flow duration to detect maximum duration of periods with presence of solely minimum flow.

Lateral connectivity could be useful to individuate sustainable frequencies of minimum flows, which are connected to a natural interchange of periods of connection and isolation of the lateral environment with the river. This could be made through a previous deepening in the knowledge of relations between connection and fluvial functionality and with the application of hydro-morphological methods to detect flow necessary for the complete connection. Indeed, a first application in Ticino river showed how wetted area characteristics and dimensions can change strongly with flow (Figure 48). For a more precise definition of these changes and to detect flows capable to completely connect lateral environment, more data are necessary.

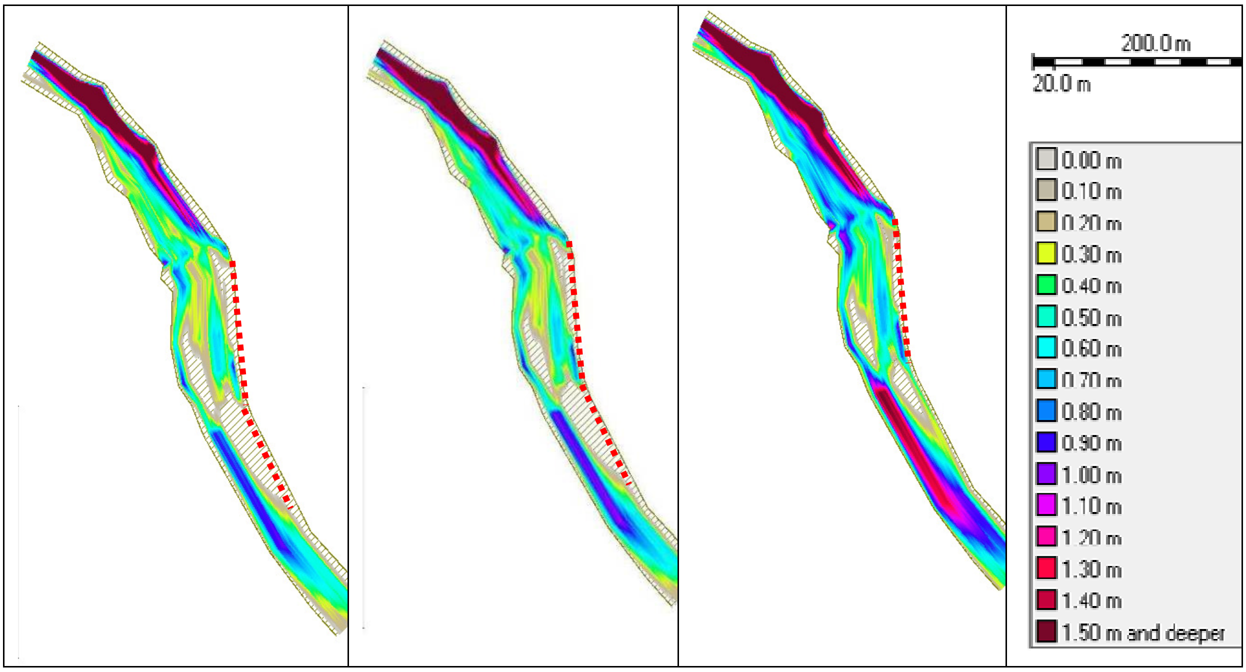


Figure 48 Changing in wetted area depth and amplitude with flow in a river reach in Ticino (dotted red line is the riparian environment).

Finally, fluvial functionality, which was studied through P, R and P/R values, represents a combination of all of the effects on ecosystem components and processes, included those previously studied. A minimum flow scheme should allow maintenance of a healthy system. In order to define river health status, however, it is necessary either to individuate reference sites to be compared with the perturbed studied ones, or to study the river system on a wide time range (with different conditions all along a year), in order to make assumptions about the acceptability of minimum flows in terms of entity and timing.

Since I measured an influence of chosen minimum flow on water temperature in summer, in contexts of specific species conservation programmes, summer minimum flows could be chosen also taking into account needs of specific fish species, for example endangered, endemic ones.

5 Conclusions

This study was developed in the field of water withdrawals management, with the aim of studying ecological effects of derivations in lotic environments and the individuation of good indicators of hydrologic alteration. The final purpose is to point out useful indications for the definition of environmental sustainable minimum flow schemes.

For the present study, I applied and critically analyzed national protocols for the study of the biological communities, as required by the WFD. These technical tools allowed an extensive characterisation of the biological communities in Ticino and Adda river, with the collection of a huge amount of data lacking from literature and local studies. Even if helpful in understanding the studied river systems, data coming from the application of these monitoring scheme clearly appeared inadequate to detect effects of hydrological alterations. In order to get over this problem, an alternative approach to macroinvertebrate fauna study was developed and applied .

The inadequacy of standard national protocols is particularly true in lowland rivers, where samplings often present practical difficulties because of river dimensions. Moreover, importance in river-floodplain connection for lowland rivers, already highlighted by Flood Pulse Concept, makes monitoring of instream communities appear non exhaustive for the description of such lotic systems. A study of river functionality, also in connection to the presence of riparian wetlands, was therefore approached.

In order to try to get specific information about hydrological alteration by macroinvertebrates, the response of benthic macroinvertebrate fauna to hydraulic parameters. Density of organisms showed a peak with medium-low values of water depth (5-30 cm) and current velocity (inferior to 0.8 m/s). Richness and diversity do not show a variation in response to local flow characteristics, while they show a weak variability in response to substrate typology of river bed, with lower values on finer substrates.

Density and richness also showed higher values in sites characterized by high stability due to prolonged low flows, combined with a general environmental (morphological and chemical) integrity. This situation is in accordance to intermediate disturbance hypothesis and leads to an important conclusion about the inadequacy of diversity and richness metrics as good quality indexes, since maximum values for these metrics are reached in conditions that, from the point of view of flows, are far from being natural.

As a further confirmation of this hypothesis, in a site characterized by very strong hydrologic alteration (TIC4), overall density diminishes.

Even if local (at subsample level) variability of density in response to flow characteristics was found, at site level, macroinvertebrates density showed a stronger variation in response to seasonality and species life-cycles, than in response to flow variation. This result excludes the possibility to use density measured for entire samples (as results from standard sampling method application) to discuss effects of flow on macroinvertebrates.

Moreover, through the creation of family-area sampling curves, I demonstrated for the studied ecosystem that the number of families increases with sampled area, following a logarithmic curve. Therefore, sampling of small areas (corresponding to few subsamples) can generate a high loss in the total number of families found, in respect to those present in the entire area to be sampled (0.5m^2 for lowland rivers). As an example, an area of 0.3 m^2 was found to correspond to 10% loss of families in respect to total sampling area.

Therefore, samples collected in sites characterised by heterogeneous substrates, leading to a small number of subsamples per substrate typology, are subject to the risk of high errors in the determination of a realistic community structure. This could have an effect also on consequent considerations and on biological status definition.

In general, benthic macroinvertebrates appeared to be not simply applicable and interpretable bioindicators for the detection of hydrological alteration effects.

Another biotic component that was not specifically studied in this work, but could be useful as bioindicator of hydrological alteration, is periphyton. Its development is influenced by flow through bed movement, nutrient load and light availability (e.g. Biggs, 1996; Brooks *et al.* 2005). An adjustment of sampling methods to accomplish this aspects should be useful and an attempt on Ticino river was already made, even if the results are not presented in this study. Although it could be difficult to discriminate different values of minimum flows by studying periphyton, its development could be related to low flow duration to detect maximum duration of periods with presence of solely minimum flow.

The functional approach to the study of ecological effects of flow variation and specifically of different experimental minimum flow volumes was based on the application of the open-channel method proposed by Odum (1956). Oxygen concentration was measured in different day hours at the beginning and at the end of a a hydrologically homogeneous river reach in Ticino river. Its variation was used to determine ecosystem respiration (R) and production (P) rates and to calculate P/R values, for different days, characterized by different flow values, from spring to late summer. Collected data showed an autotrophic metabolism, with higher values of production during summer, probably connected to aquatic vegetation development. An negative effect of high flow on production was

found, with a shift of ecosystem methabolism to heterotrophy. A weaker connection of flow with P and R values at the order of magnitude of minimum flows was visible.
Measures of oxygen and temperature daily cycles were also used to detect local variations of these parameters and to make assumptions on their potential effects on fish. Presently applied experimental values of minimum flows let water temperature reach high values during summer, ranging from 22°C and 27°C during the day, thus reaching at the upper limits of optimal temperature for Ticino fish fauna. This could give negative effects on community structure, particularly because of the coincidence of these periods of very high temperatures with fry growth period.
Additional collection of data delineating the relation among minimum flow values and ecosystem methabolism in different seasons could be useful to point out a simply applicable method, capable of detecting small differences among minimum flow values in terms of effects on the whole ecosystem.
This approach opens the direction of an alternative approach to fulfil WFD requests, which takes into account ecosystem functionality, besides community structure, for the definition of watercourses ecological status. Indeed, the importance of the use of indicators of ecosystem functionality to complete information coming from structural indicators was already stressed by Young *et al.* 2008, but never included into official normatives.

The open channel method was also applied to a river reach characterized by the presence of a riparian wetted area in partial connection with the river main channel. Results of measures, along with results of mass balances of principal nutrients and organic carbon showed how the oxbow system was able to affect the main channel chemical characteristics and oxygen metabolism. The lateral environment indeed acted as a source of nutrients and organic carbon, whereas effects on metabolism were less clear and further data are necessary to better understand this relation. As already discussed, the importance of the connection of main channel with lateral environments in lowland rivers stresses for the value of periodical complete connection of the two parts. Hydro-morphological surveys should be applied in order to detect flow value necessary for the complete connection; further measuring of ecosystem functionality in and after those conditions of high flows could better explain ecological importance of flood-pulse relationship.

All discussed effects should be useful in the definition of minimum flow schemes for the protection of river health.
Minimum flow entities should be defined as those that allow maintenance of river good functionality. In order to define the healthy functionality status of the river system to be reached, it is necessary either to individuate reference sites to be compared with the perturbed studied ones, or to study the river system on a wide time range (with different conditions all along a year).
For the definition of maximum duration of minimum flow periods, periphytic vegetation appears to be a promising indicator to be developed.

For the purpose of individualizing frequency of minimum flow interruption, the study of interaction between river and floodplain environment could be useful.

Finally, the best distribution of different minimum flow values during the year (combination of minimum flow timing and entity) could also be achieved by taking into account specific temperature needs of endangered fish species, choosing higher minimum flow values for summer period.

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Websites

Lombady lakes management corporations
www.laghi.net

Annex

Application of national protocols for biological communities sampling

Table 34 Physical and chemical data collected on Adda river used for the application of LIM_{eco} index.

date	site	N-NH4 (mg/l)	N-NO3 (mg/l)	TP (mg/l)	O2 (%)
2009-12-17	ADS1	0.025	0.791	0.029	94.8
2010-01-26	ADS1	0.042	0.773	<0.05	97.9
2010-02-17	ADS1	0.038	0.820	<0.01	104.5
2010-03-23	ADS1	0.034	0.830	0.037	105.6
2010-04-22	ADS1	0.026	0.805	0.029	101.8
2010-05-27	ADS1	0.063	0.742	0.024	101.3
2010-06-29	ADS1	0.034	0.670	0.020	112.3
2010-07-21	ADS1	<0.015	0.511	<0.01	105.3
2010-08-31	ADS1	0.020	0.415	0.550	103.7
2010-09-30	ADS1	0.036	0.501	<0.01	102.0
2010-10-21	ADS1	0.035	0.686	0.023	nodata
2010-11-23	ADS1	0.034	0.752	0.134	102.1
2010-12-16	ADS1	0.029	0.832	0.016	97.8
2011-01-27	ADS1	0.022	0.850	0.014	89.5
2011-02-23	ADS1	0.015	0.834	0.021	93.0
2011-03-31	ADS1	<0.015	0.804	0.022	110.8
2011-04-20	ADS1	<0.015	0.726	0.037	117.2
2011-05-19	ADS1	0.024	0.603	0.047	101.6
2011-06-30	ADS1	<0.015	0.503	0.023	110.5
2011-07-28	ADS1	<0.015	0.372	0.067	95.4
2011-08-30	ADS1	0.020	0.337	0.020	103.6
2011-09-30	ADS1	0.025	0.473	0.030	91.5
2011-10-27	ADS1	0.030	0.536	0.016	88.8
2011-11-30	ADS1	0.025	0.595	0.020	106.4
2011-12-20	ADS1	0.051	0.734	0.015	98.6
2012-01-26	ADS1	<0.015	0.842	0.016	102.1
2012-02-28	ADS1	0.024	0.782	0.027	105.0
2012-03-13	ADS1	0.032	0.767	0.030	108.4
2012-04-17	ADS1	0.023	0.771	0.095	103.1
2012-05-31	ADS1	0.030	0.646	<0.01	100.1
2012-06-25	ADS1	0.037	0.538	0.016	100.6
2012-07-24	ADS1	0.060	0.356	0.025	99.7
2009-12-17	ADS2	0.030	1.230	0.018	97.7
2010-01-26	ADS2	0.030	1.350	<0.05	100.8
2010-02-17	ADS2	0.022	1.510	<0.01	114.2
2010-03-23	ADS2	0.033	1.310	0.037	119
2010-04-22	ADS2	<0.015	1.430	0.021	111.1
2010-05-27	ADS2	0.048	0.910	0.034	107
2010-06-29	ADS2	0.039	0.830	0.012	112.6
2010-07-21	ADS2	0.040	0.698	<0.01	104.6
2010-08-31	ADS2	0.025	0.545	0.038	85.7
2010-09-30	ADS2	0.035	0.570	<0.01	98.5
2010-10-21	ADS2	0.060	1.340	0.030	101.4
2010-11-23	ADS2	0.032	0.786	0.047	95.5
2010-12-16	ADS2	0.031	0.918	0.021	92.6
2011-01-27	ADS2	0.025	0.895	0.017	94.2
2011-02-23	ADS2	0.036	1.610	0.023	97.2
2011-03-31	ADS2	0.071	1.510	0.023	130.5
2011-04-20	ADS2	0.051	1.530	0.028	115.2
2011-05-19	ADS2	0.024	0.864	0.055	105.7
2011-06-30	ADS2	0.020	0.781	0.023	104.6
2011-07-28	ADS2	<0.015	0.636	0.032	97.6
2011-08-30	ADS2	0.019	0.808	0.017	104.0
2011-09-30	ADS2	<0.015	1.080	0.050	85.8
2011-10-27	ADS2	0.038	1.020	<0.01	85.5
2011-11-30	ADS2	0.021	1.060	0.077	118.5
2011-12-20	ADS2	<0.015	2.020	0.018	84.5
2012-01-26	ADS2	<0.015	1.240	0.018	100.2
2012-02-28	ADS2	<0.015	1.790	0.022	102.5
2012-03-13	ADS2	0.039	1.220	0.075	97.4
2012-04-17	ADS2	0.042	1.270	0.081	106.1
2012-05-31	ADS2	0.032	0.752	<0.01	103.4
2012-06-25	ADS2	0.023	0.684	0.024	99.9
2012-07-24	ADS2	0.059	0.696	0.024	91.7
2009-12-17	ADS3	0.120	1.370	0.061	95
2010-01-26	ADS3	0.122	1.310	<0.05	97.1
2010-02-17	ADS3	<0.015	3.140	<0.01	114.1
2010-03-23	ADS3	0.035	2.830	0.018	107.7
2010-04-22	ADS3	0.077	1.260	0.05	98.5
2010-05-27	ADS3	0.058	0.909	0.047	104.9
2010-06-29	ADS3	0.058	1.090	0.015	107.8
2010-07-21	ADS3	0.043	0.805	0.022	103.7
2010-08-31	ADS3	0.028	0.721	0.037	99.0
2010-09-30	ADS3	0.034	0.971	<0.01	102.7
2010-10-21	ADS3	0.056	1.030	0.043	101.2
2010-11-23	ADS3	0.038	1.030	0.067	99.1
2010-12-16	ADS3	0.078	1.370	0.036	99.7
2011-01-27	ADS3	0.082	1.460	0.032	94.4
2011-02-23	ADS3	0.126	1.610	0.057	99.4
2011-03-31	ADS3	0.025	1.430	0.062	112.0
2011-04-20	ADS3	0.076	1.360	0.055	110.3
2011-05-19	ADS3	0.072	0.987	0.066	102.7
2011-06-30	ADS3	0.018	1.070	0.045	102.9
2011-07-28	ADS3	0.023	0.806	0.033	95.6
2011-08-30	ADS3	0.039	0.804	0.045	98.9
2011-09-30	ADS3	0.079	1.020	0.147	94.1
2011-10-27	ADS3	0.068	1.180	0.177	91.8
2011-11-30	ADS3	0.050	1.130	0.041	104.6
2011-12-20	ADS3	0.096	0.809	0.040	82.7
2012-01-26	ADS3	0.123	1.520	0.316	95.9
2012-02-28	ADS3	0.123	1.490	0.081	103.6
2012-03-13	ADS3	0.223	1.700	0.155	96.9
2012-04-17	ADS3	0.091	1.600	0.229	100.4
2012-05-31	ADS3	0.037	1.010	0.028	103.7
2012-06-25	ADS3	0.026	0.762	0.017	95.7
2012-07-24	ADS3	0.052	0.950	0.097	90.8
2009-12-17	ADS4	0.056	1.180	0.033	98.8
2010-01-26	ADS4	0.082	1.210	<0.05	95.9
2010-02-17	ADS4	0.157	1.470	<0.01	105
2010-03-23	ADS4	0.200	1.240	0.098	105.6
2010-04-22	ADS4	0.038	0.992	0.038	102.5
2010-05-27	ADS4	0.047	1.010	0.031	105.8
2010-06-29	ADS4	0.038	1.130	0.044	107.6
2010-07-21	ADS4	0.027	1.290	0.040	103.8
2010-08-31	ADS4	0.021	1.040	0.027	105.8
2010-09-30	ADS4	0.032	0.944	<0.01	101.1
2010-10-21	ADS4	0.040	1.020	0.035	100.0
2010-11-23	ADS4	0.036	1.020	0.028	97.2
2010-12-16	ADS4	0.054	1.320	0.029	98.4
2011-01-27	ADS4	0.035	1.230	0.023	97.1

date	site	N-NH4 (mg/l)	N-NO3 (mg/l)	TP (mg/l)	O2 (%)
2011-02-23	ADS4	0.043	1.410	0.044	106.8
2011-03-31	ADS4	0.023	1.500	0.043	105.7
2011-04-20	ADS4	0.023	1.440	0.033	108.2
2011-05-19	ADS4	0.032	1.370	0.041	105.1
2011-06-30	ADS4	<0.015	1.230	0.027	109.6
2011-07-28	ADS4	0.015	0.910	0.028	98.6
2011-08-30	ADS4	0.044	1.110	0.037	103.3
2011-09-30	ADS4	0.021	1.090	0.028	98.3
2011-10-27	ADS4	0.057	0.965	0.029	95.1
2011-11-30	ADS4	0.032	0.972	0.037	106.2
2011-12-20	ADS4	<0.015	1.300	0.022	97.9
2012-01-26	ADS4	<0.015	1.310	0.083	99.0
2012-02-28	ADS4	<0.015	1.480	0.043	114.8
2012-03-13	ADS4	0.036	1.400	0.112	117.5
2012-04-17	ADS4	0.060	1.410	0.066	102.8
2012-05-31	ADS4	0.035	0.926	0.032	109.3
2012-06-25	ADS4	<0.015	0.953	0.019	97.5
2012-07-24	ADS4	0.033	1.070	0.039	98.3
2009-12-17	ADS5	0.04	2.080	0.031	96
2010-01-26	ADS5	0.06	1.320	<0.05	99
2010-02-17	ADS5	0.138	1.780	0.017	102.8
2010-03-23	ADS5	0.164	1.360	0.08	103.2
2010-04-22	ADS5	0.028	1.130	0.042	97.7
2010-05-27	ADS5	0.053	1.050	0.03	105.2
2010-06-29	ADS5	0.021	1.260	0.018	105.8
2010-07-21	ADS5	0.027	1.630	<0.01	102.2
2010-08-31	ADS5	0.028	1.280	0.033	99.8
2010-09-30	ADS5	0.033	1.040	<0.01	98.4
2010-10-21	ADS5	0.034	1.130	0.036	96.8
2010-11-23	ADS5	0.043	1.080	0.068	98.6
2010-12-16	ADS5	0.049	1.630	0.028	98.4
2011-01-27	ADS5	0.028	1.370	0.024	95.7
2011-02-23	ADS5	0.048	1.640	0.043	100.3
2011-03-31	ADS5	0.020	1.640	0.036	102.5
2011-04-20	ADS5	0.025	1.690	0.038	105.3
2011-05-19	ADS5	0.028	1.690	0.044	100.1
2011-06-30	ADS5	<0.015	1.430	0.025	96.2
2011-07-28	ADS5	0.027	1.050	0.037	95.5
2011-08-30	ADS5	0.015	1.450	0.026	100.1
2011-09-30	ADS5	<0.015	1.280	0.031	102.9
2011-10-27	ADS5	0.143	1.170	0.285	95.5
2011-11-30	ADS5	<0.015	1.160	0.033	104.0
2011-12-20	ADS5	0.017	1.550	0.023	112.8
2012-01-26	ADS5	<0.015	1.660	0.044	91.6
2012-02-28	ADS5	<0.015	1.710	0.037	109.2
2012-03-13	ADS5	<0.015	1.640	0.041	104.5
2012-04-17	ADS5	0.058	1.520	0.073	100.6
2012-05-31	ADS5	<0.015	1.080	<0.01	101.9
2012-06-25	ADS5	<0.015	1.120	0.015	94.7
2012-07-24	ADS5	0.039	1.400	0.023	96.6
2009-12-17	ADS6	0.044	1.670	0.037	99.5
2010-01-26	ADS6	0.051	1.330	<0.05	96.7
2010-02-17	ADS6	0.038	1.950	<0.01	98.2
2010-03-23	ADS6	0.103	1.530	0.232	103.1
2010-04-22	ADS6	0.034	1.300	0.044	97.2
2010-05-27	ADS6	0.051	1.200	0.024	100.6

date	site	N-NH4 (mg/l)	N-NO3 (mg/l)	TP (mg/l)	O2 (%)
2010-06-29	ADS6	0.028	1.540	0.096	119.3
2010-07-21	ADS6	0.036	2.000	0.019	91.5
2010-08-31	ADS6	0.022	1.520	0.034	106.8
2010-09-30	ADS6	0.034	1.030	<0.01	97.4
2010-10-21	ADS6	0.032	1.180	0.033	96.8
2010-11-23	ADS6	0.049	1.070	0.075	97.8
2010-12-16	ADS6	0.053	1.560	0.030	96.0
2011-01-27	ADS6	0.018	1.480	0.027	93.5
2011-02-23	ADS6	0.038	1.850	0.033	119.1
2011-03-31	ADS6	0.105	1.620	0.047	99.2
2011-04-20	ADS6	0.025	1.990	0.029	99.4
2011-05-19	ADS6	0.018	2.290	0.062	88.0
2011-06-30	ADS6	0.011	1.750	0.031	103.0
2011-07-28	ADS6	<0.015	1.250	0.028	94.4
2011-08-30	ADS6	0.027	1.880	0.070	86.4
2011-09-30	ADS6	<0.015	1.490	0.106	109.2
2011-10-27	ADS6	0.069	1.090	0.034	95.7
2011-11-30	ADS6	<0.015	1.270	0.034	103.9
2011-12-20	ADS6	<0.015	1.570	0.015	110.9
2012-01-26	ADS6	0.029	2.050	0.041	83.3
2012-02-28	ADS6	0.027	1.910	0.039	117.2
2012-03-13	ADS6	0.043	1.860	0.055	85.0
2012-04-17	ADS6	0.052	1.600	0.131	96.4
2012-05-31	ADS6	0.023	1.220	<0.01	105.6
2012-06-25	ADS6	<0.015	1.310	0.017	101.2
2012-07-24	ADS6	0.083	1.780	0.023	101.5
2010-03-23	ADS7	0.097	0.899	0.072	100.6
2010-04-22	ADS7	0.039	1.310	0.043	97.8
2010-05-27	ADS7	0.047	1.170	0.022	102.8
2010-06-29	ADS7	0.025	1.570	0.046	112.8
2010-07-21	ADS7	0.037	1.830	0.022	84.8
2010-08-31	ADS7	0.035	1.540	0.052	94.7
2010-09-30	ADS7	0.037	1.110	<0.01	96.3
2010-10-21	ADS7	0.031	1.220	0.033	94.1
2010-11-23	ADS7	0.060	1.160	0.034	94.4
2010-12-16	ADS7	0.053	1.530	0.038	96.5
2011-01-27	ADS7	0.022	1.530	0.026	91.8
2011-02-23	ADS7	0.032	1.800	0.038	100.3
2011-03-31	ADS7	0.020	1.690	0.048	95.4
2011-04-20	ADS7	0.035	2.000	0.035	94.6
2011-05-19	ADS7	0.043	1.930	0.084	85.0
2011-06-30	ADS7	0.020	1.660	0.048	96.6
2011-07-28	ADS7	<0.015	1.340	0.031	95.6
2011-08-30	ADS7	0.027	1.840	0.050	82.8
2011-09-30	ADS7	0.019	1.500	0.040	103.8
2011-10-27	ADS7	0.087	1.090	0.117	94.3
2011-11-30	ADS7	<0.015	1.270	0.037	100.6
2011-12-20	ADS7	0.045	1.770	0.040	109.4
2012-01-26	ADS7	0.101	1.840	0.048	84.6
2012-02-28	ADS7	0.044	1.850	0.051	114.3
2012-03-13	ADS7	0.052	1.720	0.063	80.3
2012-04-17	ADS7	0.063	1.640	0.079	93.8
2012-05-31	ADS7	0.026	0.811	<0.01	107.2
2012-06-25	ADS7	<0.015	1.280	0.019	93.3
2012-07-24	ADS7	0.046	1.900	0.035	104.4

Table 35 Physical and chemical data collected on Ticino river used for the application of LIM_{eco} index.

date	site	N-NH4 (mg/l)	N-NO3 (mg/l)	TP (mg/l)	O2 (%)
2009-12-04	TIC1	0.030	0.897	0.012	103.8
2010-01-14	TIC1	0.025	0.818	0.0499	96.9
2010-02-10	TIC1	0.018	0.847	0.016	106.7
2010-03-12	TIC1	0.022	0.866	0.0099	105.8
2010-04-09	TIC1	0.023	0.765	0.012	110.6
2010-05-26	TIC1	0.029	0.694	0.0099	103.7
2010-06-10	TIC1	0.039	0.712	0.0099	103.5
2010-07-06	TIC1	0.050	0.611	0.011	108.1
2010-08-18	TIC1	0.053	0.506	0.011	99.3
2010-09-16	TIC1	0.024	0.574	0.019	110.6
2010-10-14	TIC1	0.023	0.571	0.0099	93.3
2010-11-25	TIC1	0.030	0.694	0.015	97.8
2010-12-15	TIC1	0.016	0.838	0.0099	102
2011-01-21	TIC1	0.024	0.821	0.014	110.5
2011-02-09	TIC1	<0.015	0.862	<0.01	120.1
2011-03-09	TIC1	<0.015	0.789	0.018	114
2011-04-07	TIC1	0.056	0.706	0.034	122.5
2011-05-05	TIC1	0.024	0.757	0.034	102.1
2011-06-15	TIC1	0.025	0.743	0.036	111.4
2011-07-07	TIC1	0.024	0.511	<0.01	95.3
2011-08-03	TIC1	0.046	0.514	0.017	105.5
2011-09-16	TIC1	0.026	0.461	0.016	91.8
2011-10-20	TIC1	0.024	0.560	0.014	100.9
2011-11-17	TIC1	<0.015	0.660	0.015	112.3
2011-12-20	TIC1	0.020	0.747	0.03	99.2
2012-01-12	TIC1	<0.015	0.768	<0.01	96.9
2012-02-23	TIC1	<0.015	0.752	0.011	99.6
2012-03-13	TIC1	0.034	0.758	0.013	110.1
2011-04-26	TIC1	0.027	0.636	0.014	113.1
2012-05-23	TIC1	0.032	0.699	0.047	103.3
2012-07-05	TIC1	0.030	0.619	0.019	96.1
2009-12-04	TIC2	0.021	0.772	0.0099	106.2
2010-01-14	TIC2	0.017	0.778	0.0499	93.3
2010-02-10	TIC2	0.016	0.841	0.0099	96.8
2010-03-12	TIC2	0.022	0.827	0.0099	108.9
2010-04-09	TIC2	0.018	0.749	0.011	117.4
2010-05-26	TIC2	0.019	0.671	0.0099	111.8
2010-06-10	TIC2	0.023	0.733	0.015	122.8
2010-07-06	TIC2	0.034	0.627	0.057	114.6
2010-08-18	TIC2	0.031	0.494	0.012	100.3
2010-09-16	TIC2	0.025	0.523	0.012	127.3
2010-10-14	TIC2	0.018	0.588	0.0099	102.6
2010-11-25	TIC2	0.041	0.722	0.018	99.0
2010-12-15	TIC2	0.015	0.785	0.016	100.6
2011-01-21	TIC2	0.016	0.736	<0.01	113.9
2011-02-09	TIC2	<0.015	0.781	0.019	118.5
2011-03-09	TIC2	<0.015	0.830	<0.01	111.7
2011-04-07	TIC2	<0.015	0.692	0.014	131.2
2011-05-05	TIC2	<0.015	0.854	0.114	103.1
2011-06-15	TIC2	0.015	0.737	0.027	137.8
2011-07-07	TIC2	<0.015	0.525	<0.01	100.4
2011-08-03	TIC2	0.086	0.509	0.115	113.3
2011-09-16	TIC2	<0.015	0.398	0.013	91.9
2011-10-20	TIC2	<0.015	0.568	0.014	106.6
2011-11-17	TIC2	<0.015	0.697	0.011	108.7
2011-12-20	TIC2	0.016	0.729	<0.01	101.5
2012-01-12	TIC2	<0.015	0.751	<0.01	102.5
2012-02-23	TIC2	0.017	0.802	0.012	97.8
2012-03-13	TIC2	<0.015	0.781	0.013	106.6
2011-04-26	TIC2	<0.015	0.624	0.02	116.5
2012-05-23	TIC2	0.025	0.659	0.151	112.5
2012-07-05	TIC2	<0.015	0.597	0.012	120.5
2009-12-04	TIC3	0.021	1.00	0.010	105.3
2010-01-14	TIC3	0.028	0.911	0.0499	101.4
2010-02-10	TIC3	0.018	0.983	0.0099	92.8
2010-03-12	TIC3	0.021	0.936	0.0099	102.4
2010-04-09	TIC3	0.022	0.846	0.019	108.2
2010-05-26	TIC3	0.018	0.722	0.020	107.7
2010-06-10	TIC3	0.025	0.760	0.010	119.5
2010-07-06	TIC3	0.041	0.769	0.013	105.7
2010-08-18	TIC3	0.039	0.577	0.0099	95.8
2010-09-16	TIC3	0.023	0.856	0.012	120.1
2010-10-14	TIC3	0.022	0.655	0.021	97.9
2010-11-25	TIC3	0.030	0.761	0.014	96.7
2010-12-15	TIC3	0.017	0.960	0.013	93.1
2011-01-21	TIC3	0.018	0.919	0.013	102.3
2011-02-09	TIC3	<0.015	0.901	0.023	105.3
2011-03-09	TIC3	<0.015	0.991	<0.01	98.7
2011-04-07	TIC3	0.024	1.030	0.017	107.2
2011-05-05	TIC3	0.024	0.904	0.043	100.9
2011-06-15	TIC3	0.016	0.922	0.034	123.1
2011-07-07	TIC3	<0.015	0.829	0.015	82.9
2011-08-03	TIC3	0.016	0.814	0.019	106.5
2011-09-16	TIC3	0.030	0.641	0.012	103.7
2011-10-20	TIC3	0.020	0.724	0.011	96.9
2011-11-17	TIC3	<0.015	0.893	<0.01	102.5
2011-12-20	TIC3	<0.015	0.877	<0.01	93.5
2012-01-12	TIC3	<0.015	0.806	<0.01	103.6
2012-02-23	TIC3	0.011	0.825	0.014	97.7
2012-03-13	TIC3	<0.015	0.927	0.01	102.5
2011-04-26	TIC3	0.024	0.792	0.018	115.2
2012-05-23	TIC3	0.05	0.688	0.017	111.7
2012-07-05	TIC3	0.034	0.913	0.013	123.2
2009-12-04	TIC4	0.028	1.16	0.024	103.8
2010-01-14	TIC4	0.042	1.07	0.0499	99.8
2010-02-10	TIC4	0.017	1.11	0.013	99.9
2010-03-12	TIC4	0.019	1.08	0.0099	112.7
2010-04-09	TIC4	0.031	0.977	0.010	111.1
2010-05-26	TIC4	0.034	0.820	0.027	108.3
2010-06-10	TIC4	0.034	0.819	0.022	128.7
2010-07-06	TIC4	0.055	0.921	0.041	100.7
2010-08-18	TIC4	0.047	0.701	0.038	91.7
2010-09-16	TIC4	0.029	0.635	0.035	134.6
2010-10-14	TIC4	0.023	0.80	0.0099	108.6
2010-11-25	TIC4	0.050	0.870	0.022	95.7
2010-12-15	TIC4	0.018	1.08	0.024	91.4
2011-01-21	TIC4	0.019	1.060	0.023	99.4
2011-02-09	TIC4	<0.015	1.080	0.03	107.1
2011-03-09	TIC4	0.019	1.060	0.022	113.7
2011-04-07	TIC4	<0.015	0.834	0.026	156.2
2011-05-05	TIC4	0.026	0.764	0.029	111.9
2011-06-15	TIC4	<0.015	0.824	0.03	134.1
2011-07-07	TIC4	0.021	0.809	0.016	88
2011-08-03	TIC4	0.074	0.698	0.023	107
2011-09-16	TIC4	0.021	0.565	0.021	170.8
2011-10-20	TIC4	0.038	0.813	0.023	100.1
2011-11-17	TIC4	<0.015	0.907	0.02	113.4
2011-12-20	TIC4	0.020	1.110	<0.01	95.0
2012-01-12	TIC4	<0.015	1.110	<0.01	112.7
2012-02-23	TIC4	0.027	1.140	0.012	105.2
2012-03-13	TIC4	0.030	1.010	0.019	113.3
2011-04-26	TIC4	0.032	0.938	0.035	118.8
2012-05-23	TIC4	0.025	0.802	0.115	114.0
2012-07-05	TIC4	0.031	0.734	0.024	123.8

Table 36 Relative abundance (%) of diatom species in Ticino river during years 2010-2012.

Code	Species	TIC1 2010-07-01	TIC2 2010-07-01	TIC3 2010-07-01	TIC4 2010-07-01	TIC1 2010-09-01	TIC2 2010-09-01	TIC3 2010-09-01	TIC4 2010-09-01	TIC1 2011-06-01	TIC2 2011-06-01	TIC3 2011-06-01	TIC4 2011-06-01	TIC1 2011-09-01	TIC2 2011-09-01	TIC3 2011-09-01	TIC4 2011-09-01	TIC1 2012-07-01	TIC2 2012-07-01	TIC3 2012-07-01	TIC4 2012-07-01
ADBI	*Achnanthidium biasolettian*um (Grunow) Lange-Bertalot	1.0	5.9	1.4	0.0	0.0	0.0	0.0	0.0	7.3	2.0	5.9	3.5	0.0	0.0	0.0	0.0	2.0	4.0	1.0	7.0
EUFL	*Eucocconeis flexella* (Kützing) Brun	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLFR	*Planothidium frequentissimum* (Lange-Bertalot)Round Bukhtiyarova	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PTLA	*Planothidium lanceolatum* (Kütz ex Bréb) L-B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.0
PRST	*Planothidium rostratum* (Oestrup) Lange-Bertalot	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADMF	*Achnanthidium minutissimum* (Kützing) Czarnvar *affinis* (Grun) Bukht	0.0	0.0	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.9	2.3	0.0	0.0	0.0	0.0	0.0	1.0
ADMI	*Achnanthidium minutissimum* (Kützing) Czarnecki	25.7	52.5	75.7	18.2	9.7	48.7	37.9	15.9	17.6	17.2	15.8	2.5	40.9	35.5	37.7	52.4	14.0	20.9	9.5	37.8
AMJA	*Achnanthes minutissima* Kutzing var. *jackii* (Rabenhorst) Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ADSU	*Achnanthidium subatomus* (Hustedt) Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	7.0
AINA	*Amphora inariensis* Krammer	1.9	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.0	1.0	8.4	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
ALIB	*Amphora libyca* Ehrenberg	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
APED	*Amphora pediculus* (Kützing) Grunow	8.6	2.0	1.9	3.2	1.5	0.5	1.0	0.0	0.5	2.9	2.0	7.9	1.0	1.8	3.8	0.0	5.0	2.0	3.0	2.0
CPED	*Cocconeis pediculus* Ehrenberg	1.9	1.0	0.0	1.7	1.9	5.1	4.3	2.5	2.9	4.9	2.5	2.0	2.9	5.9	3.8	1.7	3.0	2.0	5.0	0.0
CPLA	*Cocconeis placentula* Ehrenberg	0.0	1.0	1.0	10.4	35.0	2.0	5.3	7.0	4.9	25.5	32.5	23.8	25.0	8.2	2.8	3.5	7.0	12.4	14.0	23.9
CPLE	*Cocconeis placentula* var. euglypta (Ehr) Grunow	1.0	0.0	0.0	3.5	3.9	0.0	0.0	1.0	1.0	2.0	1.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CPLI	*Cocconeis placentula* var. *lineata* (Ehr) Van Heurck	17.1	2.9	2.9	2.0	0.0	0.0	0.0	0.0	27.3	9.8	15.8	10.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CPPL	*Cocconeis placentula* var. *pseudolineata* Geitler	6.7	1.0	0.0	2.0	0.0	0.0	0.5	0.0	4.9	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COCE	*Cyclotella meneghiniana* Kützing	8.6	10.8	1.0	3.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.5	1.5	1.0	0.0
CAFF	*Cymbella affinis* Kützing	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
ECAE	*Encyonema caespitosum* Kützing	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.9	0.0	0.9	0.0	0.0	0.5	0.0	0.0
CCMP	*Cymbella compacta* Ostrup	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0
CLAE	*Encyonopsis microcephala* (Grunow) Krammer	0.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	2.0	0.5	0.0	1.0	0.0	2.4	2.6	1.0	0.0	0.0	0.0
CBNA	*Encyonema minutum* (Hilse) Mann	0.0	0.0	1.4	5.2	3.9	2.2	2.9	2.0	4.4	5.4	4.9	3.5	1.9	1.8	0.9	5.6	6.0	4.0	9.0	6.0
EPRO	Encyonema prostratum (Berkeley) Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
ESLE	*Encyonema silesiacum* (Bleisch) Mann	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RSIN	Reimeria sinuata (Gregory) Kociolek Stoermer	9.5	9.8	7.6	39.8	3.9	0.0	1.0	1.0	4.9	3.4	2.5	9.4	1.9	1.4	0.0	3.9	5.0	6.0	5.0	7.0
DTEN	*Denticula tenuis* Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.9	1.0	0.0	0.0	0.0	0.9	0.0	1.0	0.5	0.0	0.0
DTCR	*Denticula tenuis* var. *crassula* (Naegeli) Hustedt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0
DEHR	*Diatoma ehrenbergii* Kutzing	1.0	2.0	0.0	0.0	3.9	3.4	2.7	1.0	0.0	0.0	0.0	0.0	1.0	9.5	5.2	1.7	6.0	3.0	2.0	0.0
DMES	*Diatoma mesodon* (Ehrenberg) Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DVUL	*Diatoma vulgaris* Bory	0.0	0.0	0.0	0.0	0.5	0.5	0.0	1.0	1.5	0.0	0.0	1.0	0.0	0.0	0.0	0.9	5.0	0.0	1.0	0.0
DGEM	*Didymosphenia geminata* Metzeltin Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
EADN	*Epithemia adnata* (Kützing) Brébisson	0.5	1.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	1.0	1.0	0.0	1.0	3.6	1.9	0.0	1.0	0.5	0.0	0.0
PSBR	*Pseudostaurosira brevistriata* Williams Round	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FCAP	*Fragilaria capucina* Desmazières	0.0	0.0	0.0	0.0	9.2	17.6	4.8	28.9	0.0	0.0	0.0	0.0	0.0	0.9	14.6	0.0	0.0	0.0	0.0	0.0
FCRP	*Fragilaria capucina* Desmazieres var. *rumpens* (Kutzing) Lange-Bertalot	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FCCP	*Fragilaria capucina* Desmazieres var. *capitellata* (Grunow) Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FCME	*Fragilaria capucina* Desmazieres var.*mesolepta* (Rabenhorst) Rabenhorst	0.0	0.0	0.0	0.0	1.9	0.5	1.0	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FCVA	*Fragilaria capucina* var. *vaucheriae* (Kutzing) Lange-Bertalot	1.0	3.9	0.0	0.0	5.3	12.2	20.8	7.0	2.4	2.9	2.0	0.0	3.8	4.5	2.8	4.8	8.0	10.4	24.9	3.0
SSVE	*Staurosira venter* (Ehrenberg) Cleve Moeller	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
FCRO	*Fragilaria crotonensis* Kitton	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.0	0.0	0.0	0.0	5.3	0.9	2.8	6.5	3.0	12.9	5.0	0.0

Code	Species	TIC1 2010-07-01	TIC2 2010-07-01	TIC3 2010-07-01	TIC4 2010-07-01	TIC1 2010-09-01	TIC2 2010-09-01	TIC3 2010-09-01	TIC4 2010-09-01	TIC1 2011-06-01	TIC2 2011-06-01	TIC3 2011-06-01	TIC4 2011-06-01	TIC1 2011-09-01	TIC2 2011-09-01	TIC3 2011-09-01	TIC4 2011-09-01	TIC1 2012-07-01	TIC2 2012-07-01	TIC3 2012-07-01	TIC4 2012-07-01
PPSC	*Pseudostaurosira parasitica* var. subconstricta (Grunow)Morales	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SRPI	*Staurosira pinnata* Ehrenberg	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FTEN	*Fragilaria tenera* (W Smith) Lange-Bertalot	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0
UULN	*Ulnaria ulna* (Nitzsch) Compère	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.5	0.0	0.0	0.0	0.0	0.5	3.2	0.0	0.4	0.0	0.0	0.0	0.0
GMIN	*Gomphonema minutum* (Agardh) Agardh	1.0	0.5	1.0	1.0	0.0	0.0	0.0	0.0	0.0	1.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
GOLI	*Gomphonema olivaceum* (Hornemann) Brébisson	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GPAR	*Gomphonema parvulum* (Kützing) Kützing	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0
GPUM	*Gomphonema pumilum* (Gr) Reichardt Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.9	0.0	0.4	0.0	0.0	0.0	0.0
GTER	*Gomphonema tergestinum* Fricke	3.3	1.0	5.2	1.5	1.9	0.0	0.5	1.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GTRU	*Gomphonema truncatum* Ehrenberg	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MVAR	*Melosira varians* Agardh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
NANT	*Navicula antonii* Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NCPR	*Navicula capitatoradiata* Germain	0.0	0.0	0.0	0.0	1.0	0.2	0.0	3.0	0.0	0.0	0.0	0.5	0.0	0.5	0.5	0.4	0.0	2.5	0.0	1.0
NCTE	*Navicula cryptotenella* Lange-Bertalot	1.9	0.0	0.0	1.0	1.9	0.5	0.0	2.0	4.9	2.9	0.5	4.0	1.9	1.4	1.4	2.6	5.0	0.0	2.0	1.0
NGRE	*Navicula gregaria* Donkin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NJAK	*Navicula jakovljevicii* Hustedt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	0.0	0.0
NLAN	*Navicula lanceolata* (Agardh) Ehrenberg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
NVDS	*Naviculadicta seminulum* (Grunow) Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NSPD	*Navicula splendicula* Van Landingham	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
NTPT	*Navicula tripunctata* (Müller) Bory	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.5	0.5	0.0	0.0	0.5	0.0	1.4	0.0	1.0	0.0	1.0	0.0
NACI	*Nitzschia acicularis* (Kützing) W M Smith	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	0.0
NAMP	*Nitzschia amphibia* Grunow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0
NDIS	Nitzschia dissipata (Kützing) Grunow	0.0	1.0	0.0	0.0	1.0	0.5	1.9	2.0	1.0	1.5	0.0	1.0	1.0	1.8	0.9	0.0	3.0	2.0	1.0	0.0
NFON	*Nitzschia fonticola* Grunow	0.0	0.0	0.0	2.0	0.0	0.5	1.4	2.0	1.5	0.0	2.5	2.0	0.0	2.3	0.9	2.6	3.0	2.0	4.0	1.0
NIFR	*Nitzschia frustulum* (Kützing) Grunow	0.0	0.0	0.0	0.0	0.0	1.0	0.0	3.5	0.0	0.0	0.0	0.0	1.0	3.2	2.8	0.0	0.0	0.0	0.0	0.0
NLIN	*Nitzschia linearis* (Agardh) W Smith	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
NPAL	*Nitzschia palea* (Kützing) W Smith	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	2.0
NPAE	*Nitzschia paleacea* (Grunow) Grunow	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	1.0	1.0	0.0
NSIT	*Nitzschia sinuata* (Thwaites) Grunow var. *tabellaria* Grunow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
RUNI	*Reimeria uniseriata* Sala Guerrero Ferrario	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.0	4.4	1.0	1.0	0.0	1.9	0.0	0.0	1.0	0.0	0.0
RABB	*Rhoicosphenia abbreviata* (Agardh) Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TFLO	*Tabellaria flocculosa* (Roth) Kützing	2.9	0.0	0.5	0.7	0.0	0.0	0.0	0.0	1.0	0.0	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cyclotella comensis	0.0	0.0	0.0	0.5	3.9	1.5	0.0	3.0	1.0	0.0	0.0	1.0	3.4	1.4	0.0	0.4	0.0	0.2	0.0	0.0
	Cymbella excisa	0.0	0.0	0.0	0.0	1.0	0.5	0.0	0.0	1.0	0.0	1.5	1.0	0.5	5.9	5.7	4.8	0.2	0.2	0.2	0.5
	Cymbella sp	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
	Cyclotella sp	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cyclotella cyclopuncta	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nitzschia sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Navicula sp.	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Achnanthes sp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0
	Fragilaria sp	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cymbella affiniformis	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOT	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 37 Relative abundance (%) of diatom species in Adda river during years 2010-2012.

Code	Species	ADS1 2010-06-01	ADS1 2010-09-01	ADS1 2011-06-01	ADS1 2011-08-01	ADS1 2012-06-01	ADS2 2010-06-01	ADS2 2010-09-01	ADS2 2011-06-01	ADS2 2011-08-01	ADS2 2012-06-01	ADS3 2010-06-01	ADS3 2010-09-01	ADS3 2011-06-01	ADS3 2011-08-01	ADS3 2012-06-01
ADBI	*Achnanthidium biasolettianum* (Grunow) Lange-Bertalot	0.0	0.4	0.5	0.9	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.9	1.5
PLFR	*Planothidium frequentissimum* (Lange-Bertalot) Round Bukhtiyarova	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
PTLA	*Planothidium lanceolatum* (Kütz ex Bréb) L-B	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0	0.9	1.0	0.0	1.0
ADMI	*Achnanthidium minutissimum* (Kützing) Czarnecki	8.3	21.3	3.4	8.0	10.0	14.4	4.6	0.9	9.5	11.4	8.2	12.8	0.5	3.3	11.8
ADSU	*Achnanthidium subatomus* (Hustedt) Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
AINA	*Amphora inariensis* Krammer	0.0	0.5	3.8	2.2	0.0	10.4	0.7	1.4	5.7	1.5	2.0	1.9	6.7	0.9	3.0
ALIB	*Amphora libyca* Ehrenberg	0.0	0.0	1.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
APED	*Amphora pediculus* (Kützing) Grunow	7.3	2.7	1.0	1.8	23.5	16.8	1.4	2.8	7.6	7.7	14.9	16.1	5.3	2.8	14.3
AFOR	*Asterionella formosa* Hassall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0
CBAC	*Caloneis bacillum* (Grunow) Cleve	0.0	0.3	0.0	0.0	0.0	0.5	0.0	1.9	0.5	0.5	0.5	0.0	0.0	0.0	0.0
CPED	*Cocconeis pediculus* Ehrenberg	7.3	6.6	8.7	0.9	4.3	2.5	8.4	5.2	4.3	3.7	2.0	0.0	0.0	2.8	1.5
CPLA	*Cocconeis placentula* Ehrenberg	33.0	1.6	15.4	7.1	9.5	6.9	18.2	2.8	13.7	15.8	25.5	12.8	3.8	20.7	8.4
CPLE	*Cocconeis placentula* var. euglypta (Ehr) Grunow	1.8	1.1	1.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.0	1.9	0.0
CPPL	*Cocconeis placentula* var. *pseudolineata* Geitler	1.8	0.0	1.0	0.0	3.0	0.5	0.7	0.0	0.0	0.5	1.0	0.5	0.0	4.2	1.0
CCOM	*Cyclotella comta* (Ehr)Kutzing	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CMEN	*Cyclotella kuetzingiana* Thwaites	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.5	0.0
COCE	*Cyclotella meneghiniana* Kützing	0.0	0.0	1.0	1.3	0.0	0.0	1.4	0.5	0.5	0.2	0.5	0.0	0.5	0.0	0.0
CAFF	*Cymbella affinis* Kützing	0.0	0.4	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CLAE	*Encyonopsis microcephala* (Grunow) Krammer	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CBNA	*Encyonema minutum* (Hilse) Mann	1.8	0.5	1.0	1.3	4.0	0.0	0.0	0.9	0.0	2.2	1.5	1.7	4.3	1.9	1.0
EPRO	Encyonema prostratum (Berkeley) Kützing	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.9	0.5	0.5	0.0	0.0	0.0	0.0	0.0
ESLE	*Encyonema silesiacum* (Bleisch) Mann	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.0	0.0	0.0
RSIN	Reimeria sinuata (Gregory) Kociolek Stoermer	1.8	0.5	2.9	0.0	11.0	0.0	0.7	0.0	0.0	0.0	23.0	11.4	6.7	1.9	8.9
DEHR	*Diatoma ehrenbergii* Kutzing	0.0	9.8	18.8	0.9	0.5	0.0	17.2	10.4	0.5	0.5	1.5	1.4	1.0	2.3	0.7
DITE	*Diatoma tenuis* Agardh	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
DVUL	*Diatoma vulgaris* Bory	0.0	0.0	6.7	0.9	0.0	0.0	3.9	2.8	1.4	0.7	0.0	0.7	3.8	0.9	0.5
PSBR	*Pseudostaurosira brevistriata* Williams Round	0.0	0.9	0.5	0.9	0.0	1.0	0.0	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0
FCVA	*Fragilaria capucina* var. *vaucheriae* (Kutzing) Lange-Bertalot	1.8	3.3	5.3	0.9	1.5	3.5	2.8	6.6	0.0	1.0	1.7	0.9	5.8	1.9	1.0
FCRO	*Fragilaria crotonensis* Kitton	0.0	0.5	4.8	1.8	0.0	1.0	0.0	0.5	2.8	0.0	0.0	0.5	0.0	0.5	0.0
PPRS	*Pseudostaurosira parasitica* (W Smith) Morales	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SRPI	*Staurosira pinnata* Ehrenberg	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5
FUAC	*Fragilaria ulna* var. *acus* (Kützing) Lange-Bertalot	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
FVUL	*Frustulia vulgaris* (Thwaites) De Toni	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GMIN	*Gomphonema minutum* (Agardh) Agardh	3.7	1.1	2.9	0.0	0.0	3.0	0.7	2.4	0.0	1.5	0.2	0.7	5.8	0.0	0.0
GOLI	*Gomphonema olivaceum* (Hornemann) Brébisson	0.0	2.7	0.0	0.4	0.8	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
GPAR	*Gomphonema parvulum* (Kützing) Kützing	0.0	0.4	1.0	0.0	1.5	0.5	0.0	0.0	0.0	0.0	0.0	0.5	2.4	0.0	1.0
GPUM	*Gomphonema pumilum* (Gr) Reichardt Lange-Bertalot	0.0	1.6	0.5	0.4	2.5	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.0	0.5	0.0
GTER	*Gomphonema tergestinum* Fricke	0.0	0.0	0.0	0.0	0.8	0.0	0.7	0.0	0.0	0.0	0.5	3.3	3.4	0.0	0.5
GNOD	*Gyrosigma nodiferum* (Grunow) Reimer	0.0	0.0	0.0	0.0	0.0	0.5	0.7	2.4	0.9	0.7	0.0	0.0	0.0	0.0	0.0
MVAR	*Melosira varians* Agardh	0.0	0.9	0.0	0.0	0.0	0.0	4.2	4.7	0.5	0.0	0.0	0.0	0.0	0.0	0.5

Code	Species	ADS1 2010-06-01	ADS1 2010-09-01	ADS1 2011-06-01	ADS1 2011-08-01	ADS1 2012-06-01	ADS2 2010-06-01	ADS2 2010-09-01	ADS2 2011-06-01	ADS2 2011-08-01	ADS2 2012-06-01	ADS3 2010-06-01	ADS3 2010-09-01	ADS3 2011-06-01	ADS3 2011-08-01	ADS3 2012-06-01
CRAC	*Craticula accomoda* (Hustedt) Mann	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
NANT	*Navicula antonii* Lange-Bertalot	0.0	0.9	0.0	1.3	0.5	0.0	0.0	2.4	0.0	0.7	0.0	1.4	0.0	0.5	0.5
MAPE	*Mayamaea atomus* var *permitis* (Hustedt) Lange-Bertalot	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	1.5	10.9	0.0	0.0	15.3
NCPR	*Navicula capitatoradiata* Germain	1.8	2.0	0.0	0.0	0.0	0.0	3.2	0.9	0.9	0.0	0.0	0.9	0.5	2.3	0.0
NCTE	*Navicula cryptotenella* Lange-Bertalot	9.2	4.4	1.9	5.8	5.5	11.4	7.4	6.6	11.8	4.9	3.2	0.2	1.4	15.0	3.4
NGRE	*Navicula gregaria* Donkin	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.7
NJAK	*Navicula jakovljevicii* Hustedt	0.0	0.0	1.0	0.9	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NLAN	*Navicula lanceolata* (Agardh) Ehrenberg	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NMEN	*Navicula menisculus* Schumann	1.8	0.0	1.0	0.0	0.5	1.0	0.7	0.9	0.9	0.7	0.5	0.0	2.4	0.5	0.5
EOMI	*Eolimna minima* (Grunow) Lange-Bertalot	0.0	0.0	1.0	0.0	0.0	5.9	0.0	0.5	0.0	0.7	0.0	0.0	0.0	0.0	0.5
NPRA	*Navicula praeterita* Hustedt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPUP	*Sellaphora pupula* (Kützing) Mereschkowsky	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
NRCH	*Navicula reichardtiana* Lange-Bertalot	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.4	0.5	1.0	1.0	0.0	2.9	0.5	1.5
NSPD	*Navicula splendicula* Van Landingham	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.4	0.0	0.5
FSBM	*Fallacia subhamulata* (Grunow) Mann	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.5
ESBM	*Eolimna subminuscula* (Manguin) Moser. L-B Metzeltin	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
NTPT	*Navicula tripunctata* (Müller) Bory	3.7	4.2	2.4	2.7	0.0	3.5	4.6	20.3	18.5	21.0	0.5	1.2	0.0	12.7	1.7
NVEN	*Navicula veneta* Kützing	0.9	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.5
NAMP	*Nitzschia amphibia* Grunow	0.0	0.0	0.0	0.0	0.3	0.0	0.4	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
NCPL	*Nitzschia capitellata* Hustedt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.5
NDIS	Nitzschia dissipata (Kützing) Grunow	3.7	7.1	1.9	1.3	1.0	4.0	3.9	4.7	7.1	3.7	1.5	2.4	2.4	1.9	0.0
NFON	*Nitzschia fonticola* Grunow	5.5	0.9	4.3	1.3	3.5	7.4	1.8	1.4	1.4	4.9	4.2	3.6	16.8	1.4	5.4
NIFR	*Nitzschia frustulum* (Kützing) Grunow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
NINC	*Nitzschia inconspicua* Grunow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
NLIN	*Nitzschia linearis* (Agardh) W Smith	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0
NPAL	*Nitzschia palea* (Kützing) W Smith	0.0	0.0	1.9	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.5	2.1	7.2	0.5	1.0
NREC	*Nitzschia recta* Hantzsch	0.0	0.0	0.0	0.0	0.8	0.0	0.0	1.9	0.0	2.7	0.0	0.0	0.0	0.0	0.0
NSOL	*Nitzschia sinuata* var. *delognei* (Grunow) Lange-Bertalot	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RUNI	*Reimeria uniseriata* Sala Guerrero Ferrario	1.8	0.0	0.0	0.9	1.5	0.0	0.0	0.0	0.5	0.5	3.0	0.7	4.8	1.9	1.2
RABB	*Rhoicosphenia abbreviata* (Agardh) Lange-Bertalot	0.0	1.1	1.4	0.0	0.5	2.0	0.7	4.7	1.9	8.4	0.0	0.5	2.9	1.9	2.0
SANG	*Surirella angusta* Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
SBRE	*Surirella brebissonii* Krammer Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
	Cyclotella comensis	0.0	18.7	1.0	50.9	0.0	0.0	9.4	2.8	4.7	0.2	0.0	4.5	0.0	10.3	0.0
	Encyonema ventricosum (Agarth) Grunow	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Encyonopsis subminuta (Krammer et Reichardt)	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fragilara sp.	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gomphonema insigne Gregory	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Placoneis gastrum (Ehremberg)Kutzing var gastrum	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Navicula rotunda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Nitschia sp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cymbella excisa Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.9	0.5
	Alaucoseira sp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
	Tabellaria sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
	Navicula submolesta Husted	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
	TOT	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Code	Species	ADS4 2010-06-01	ADS4 2010-09-01	ADS4 2011-06-01	ADS4 2011-08-01	ADS4 2012-06-01	ADS5 2010-06-01	ADS5 2010-09-01	ADS5 2011-06-01	ADS5 2011-08-01	ADS5 2012-06-01	ADS6 2010-06-01	ADS6 2010-09-01	ADS6 2011-06-01	ADS6 2011-08-01	ADS6 2012-06-01	ADS7 2010-06-01	ADS7 2010-09-01	ADS7 2011-06-01	ADS7 2011-08-01	ADS7 2012-06-01
ADBI	*Achnanthidium biasolettian*um (Grunow) Lange-Bertalot	0.5	1.9	2.0	1.0	0.5	3.0	1.2	2.0	2.4	12.5	1.2	1.4	1.0	7.2	0.0	0.2	1.2	0.0	2.3	1.5
PLFR	*Planothidium frequentissimum* (Lange-Bertalot)Round Bukhtiyarova	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
PTLA	*Planothidium lanceolatum* (Kütz ex Bréb) L-B	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0
ADMF	*Achnanthidium minutissimum* (Kützing) Czarnvar *affinis* (Grun) Bukht	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0
ADMI	*Achnanthidium minutissimum* (Kützing) Czarnecki	4.2	9.6	31.4	7.4	7.7	18.0	7.1	7.9	15.5	17.0	7.3	4.8	8.6	15.8	2.5	5.0	0.0	0.5	9.3	5.5
KPLO	*Kolbesia ploenensis* (Hustedt) Kingston	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AINA	*Amphora inariensis* Krammer	4.5	1.6	0.0	5.9	2.4	0.0	0.7	0.0	0.5	0.0	0.0	0.0	0.0	0.9	0.5	0.0	0.0	0.0	2.8	0.0
ALIB	*Amphora libyca* Ehrenberg	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.0	0.0	0.0	0.0
APED	*Amphora pediculus* (Kützing) Grunow	10.9	7.1	2.0	1.5	5.8	12.8	2.8	0.0	4.9	5.5	12.2	1.8	2.4	2.7	5.5	8.2	14.0	2.9	13.0	16.2
CPED	*Cocconeis pediculus* Ehrenberg	0.0	0.0	0.0	5.9	1.9	0.0	1.2	0.0	4.9	1.0	0.0	1.6	1.0	5.4	0.0	1.0	3.4	0.0	2.3	1.0
CPLA	*Cocconeis placentula* Ehrenberg	25.8	8.0	1.0	30.5	8.2	6.0	3.3	7.9	24.3	5.5	1.9	3.5	1.0	8.1	0.5	0.5	5.8	1.0	11.2	1.0
CPLE	*Cocconeis placentula* var. euglypta (Ehr) Grunow	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CPLI	*Cocconeis placentula* var. *lineata* (Ehr) Van Heurck	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CPPL	*Cocconeis placentula* var. *pseudolineata* Geitler	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CATO	*Cyclotella atomus* Hustedt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
CCOM	*Cyclotella comta* (Ehr)Kutzing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
CMEN	*Cyclotella kuetzingiana* Thwaites	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.2	0.0	1.4	0.0
COCE	*Cyclotella meneghiniana* Kützing	0.0	0.5	1.0	1.0	0.2	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.9	0.0
CAFF	*Cymbella affinis* Kützing	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	1.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
ECAE	*Encyonema caespitosum* Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
CBNA	*Encyonema minutum* (Hilse) Mann	1.5	0.9	3.9	1.0	1.0	4.5	0.9	3.4	0.5	0.0	2.4	0.9	1.4	0.0	1.0	1.0	1.0	0.5	0.9	1.0
ESLE	*Encyonema silesiacum* (Bleisch) Mann	0.5	0.0	0.5	1.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RSIN	Reimeria sinuata (Gregory) Kociolek Stoermer	34.7	8.2	2.9	3.4	30.3	23.5	0.9	22.2	4.9	33.5	17.3	6.0	2.9	1.8	16.0	11.4	5.3	9.1	5.6	16.5
CTUM	*Cymbella tumida* (Brébisson) Van Heurck	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
DEHR	*Diatoma ehrenbergii* Kutzing	2.0	39.1	5.9	0.5	0.0	1.0	36.7	1.0	0.0	0.0	0.5	17.3	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0
DVUL	*Diatoma vulgaris* Bory	0.0	0.5	3.4	0.5	0.0	1.0	2.4	2.0	2.9	0.5	0.0	4.4	1.4	5.4	1.0	0.0	1.4	0.0	3.3	0.0
FARC	*Fragilaria arcus* (Ehrenberg) Cleve	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
FCAP	*Fragilaria capucina* Desmazières	0.0	0.0	2.9	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FCVA	*Fragilaria capucina* var. *vaucheriae* (Kutzing) Lange-Bertalot	0.0	0.9	4.4	0.0	1.9	0.5	2.8	6.9	0.0	0.0	0.5	4.4	4.8	0.9	2.0	0.0	2.9	0.5	0.9	0.0
FCRO	*Fragilaria crotonensis* Kitton	0.0	0.2	0.0	3.9	0.0	0.0	1.9	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SRPI	*Staurosira pinnata* Ehrenberg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0
UULN	*Ulnaria ulna* (Nitzsch) Compère	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.5	0.0	0.0	0.0	0.7	0.0	3.3	0.0
FUAC	*Fragilaria ulna* var. *acus* (Kützing) Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.5	0.0	0.0	0.0	0.9	0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0
GANG	*Gomphonema angustatum* (Kützing) Rabenhorst	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
GMIN	*Gomphonema minutum* (Agardh) Agardh	0.0	0.5	1.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.9	0.2	1.0	0.0	0.0	0.0	0.2
GOLI	*Gomphonema olivaceum* (Hornemann) Brébisson	0.0	0.0	0.0	0.0	0.5	0.5	0.0	1.0	0.0	0.3	4.4	0.0	1.0	0.0	0.0	2.2	1.0	0.0	0.0	0.0
GPAR	*Gomphonema parvulum* (Kützing) Kützing	0.2	0.0	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.5	1.8	0.0	0.9	2.0	0.0	1.0	0.0	0.0	1.0
GPRO	*Gomphonema productum* (Gr) L-B Reichardt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
GPUM	*Gomphonema pumilum* (Gr) Reichardt Lange-Bertalot	0.2	0.2	0.0	0.0	0.5	0.0	0.2	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
GTER	*Gomphonema tergestinum* Fricke	0.2	1.9	0.5	0.0	1.5	1.5	1.7	4.9	0.0	1.3	3.9	0.5	0.0	2.3	2.5	2.2	0.7	0.0	0.0	1.0
GTRU	*Gomphonema truncatum* Ehrenberg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
MVAR	*Melosira varians* Agardh	0.0	0.5	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	6.5	1.0	4.5	0.5	0.0	5.8	0.0	0.9	2.0
CRAC	*Craticula accomoda* (Hustedt) Mann	0.0	0.0	0.0	0.0	0.0	0.5	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NANT	*Navicula antonii* Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	3.6	0.0	0.9	0.0
MAPE	*Mayamaea atomus* var *permitis* (Hustedt) Lange-Bertalot	2.5	0.0	3.9	0.0	22.5	4.5	0.0	0.0	0.0	8.5	30.2	0.0	42.6	0.0	44.4	47.0	1.9	70.7	0.0	31.9
HCAP	*Hippodonta capitata* (Ehr) L-B. Metzeltin Witkowski	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NCPR	*Navicula capitatoradiata* Germain	0.0	0.5	0.0	5.9	0.0	0.0	2.1	0.0	0.5	0.0	0.0	1.2	0.0	3.2	0.2	0.0	1.9	0.0	1.9	0.0

Code	Species	ADS4 2010-06-01	ADS4 2010-09-01	ADS4 2011-06-01	ADS4 2011-08-01	ADS4 2012-06-01	ADS5 2010-06-01	ADS5 2010-09-01	ADS5 2011-06-01	ADS5 2011-08-01	ADS5 2012-06-01	ADS6 2010-06-01	ADS6 2010-09-01	ADS6 2011-06-01	ADS6 2011-08-01	ADS6 2012-06-01	ADS7 2010-06-01	ADS7 2010-09-01	ADS7 2011-06-01	ADS7 2011-08-01	ADS7 2012-06-01
NCTE	*Navicula cryptotenella* Lange-Bertalot	0.5	1.2	1.5	0.0	1.5	5.8	2.4	3.0	1.9	1.5	1.9	5.1	1.4	3.6	1.0	1.7	4.1	0.5	3.7	1.0
GDEC	*Geissleria decussis (*Oestrup) Lange-Bertalot Metzeltin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.2	5.6	0.0	0.0	0.0
NGRE	*Navicula gregaria* Donkin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.9	1.4	0.9	0.5	0.5	0.2	0.0	1.4	0.0
NMEN	*Navicula menisculus* Schumann	0.5	0.0	1.0	0.0	1.0	1.0	0.0	2.5	0.0	0.5	1.0	1.6	1.9	0.9	1.0	1.2	0.7	0.5	0.0	1.0
EOMI	*Eolimna minima* (Grunow) Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.7	2.2	0.0	0.0	0.5
FPEL	*Fistulifera pelliculosa* (Brébisson) Lange-Bertalot	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NPHY	*Navicula phyllepta* Kützing	0.0	0.7	0.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
PPLC	*Placoneis placentula* (Ehrenberg) Heinzrling	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPUP	*Sellaphora pupula* (Kützing) Mereschkowsky	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NRAD	*Navicula radiosa* Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NRCH	*Navicula reichardtiana* Lange-Bertalot	0.5	0.5	3.4	1.0	0.5	0.0	1.7	1.5	0.0	0.3	1.5	3.0	3.8	1.8	0.5	1.0	0.7	1.9	0.0	0.5
NSPD	*Navicula splendicula* Van Landingham	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.9	1.4	0.5	1.8	0.0	0.0	2.4	0.0	0.0	0.5
FSBM	*Fallacia subhamulata* (Grunow) Mann	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESBM	*Eolimna subminuscula* (Manguin) Moser. L-B Metzeltin	0.0	0.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	1.0	0.5	0.5	2.0
NTPT	*Navicula tripunctata* (Müller) Bory	0.0	0.5	0.5	4.9	0.5	0.0	0.0	1.0	1.0	0.5	0.0	2.3	1.0	0.9	0.0	0.2	2.2	0.5	1.9	0.0
NVEN	*Navicula veneta* Kützing	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0
NVRO	*Navicula viridula* var. *rostellata* (Kützing) Cleve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0
NACI	*Nitzschia acicularis* (Kützing) W M Smith	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.5
NAMP	*Nitzschia amphibia* Grunow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
NCPL	*Nitzschia capitellata* Hustedt	0.0	0.5	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	1.4	0.0	1.0	0.2	0.0	1.9	0.0	0.5
NDIS	Nitzschia dissipata (Kützing) Grunow	1.0	1.9	2.0	0.0	1.9	4.5	1.9	0.5	1.0	2.0	1.0	5.3	1.9	0.9	2.0	1.0	2.2	1.0	3.3	1.0
NFON	*Nitzschia fonticola* Grunow	1.0	0.9	9.8	2.0	3.6	8.0	1.4	8.4	4.4	4.5	6.8	2.8	6.7	11.7	3.5	10.9	0.7	4.3	8.4	2.5
NIFR	*Nitzschia frustulum* (Kützing) Grunow	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.8	1.0
NIGR	*Nitzschia gracilis* Hantzsch	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINC	*Nitzschia inconspicua* Grunow	0.7	0.0	2.9	0.0	1.5	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
NLIN	*Nitzschia linearis* (Agardh) W Smith	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NPAL	*Nitzschia palea* (Kützing) W Smith	0.0	1.4	7.8	0.5	0.0	0.0	13.3	1.5	1.0	1.0	1.0	2.5	5.3	1.8	6.0	1.2	1.4	2.4	2.8	5.5
NPAE	*Nitzschia paleacea* (Grunow) Grunow	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0
NREC	*Nitzschia recta* Hantzsch	0.0	0.5	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.9	0.0
NSIN	*Nitzschia sinuata* (Thwaites) Grunow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NSIT	*Nitzschia sinuata* (Thwaites) Grunow var. *tabellaria* Grunow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NSOL	*Nitzschia sinuata* var. *delognei (*Grunow) Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NSOC	*Nitzschia sociabilis* Hustedt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
RUNI	*Reimeria uniseriata* Sala Guerrero Ferrario	4.7	0.9	0.0	3.4	1.5	0.0	0.5	1.0	17.0	1.3	1.7	0.0	1.0	2.3	0.0	0.0	1.0	0.0	4.7	0.0
RABB	*Rhoicosphenia abbreviata* (Agardh) Lange-Bertalot	0.0	0.9	2.0	0.0	0.2	0.0	0.7	0.0	3.9	1.5	0.0	1.6	0.0	0.9	1.0	0.0	0.5	0.0	2.8	1.0
SANG	*Surirella angusta* Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SBRE	*Surirella brebissonii* Krammer Lange-Bertalot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cyclotella comensis	0.0	4.5	0.0	11.3	0.5	0.0	4.0	0.0	2.4	0.0	0.0	1.4	0.5	1.4	0.2	0.0	1.9	0.0	0.9	0.0
	Fragilara sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Placoneis gastrum (Ehremberg)Kutzing var gastrum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cymbella excisa Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.5	0.0
	Tabellaria sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	Nitzschia perminuta (Grunow) M Peragallo	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Aulacoseira granulata (Ehremberg) Simonsen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cyclotella meneghiniana Kützing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Navicula caterva	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOT	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 38 Real and relative cover of macrophytes in Ticino river in 2010 and 2011.

site	date	year	group	species	relative cover %	real cover %
TIC1	2010-09-21	2010	Algae	*Cladophora sp.*	70	42
TIC1	2010-09-21	2010	Algae	*Spirogyra sp.*	30	18
TIC1	2010-09-21	2010	Algae	*Hydrodiction sp.*	+	<0.1
TIC1	2010-09-21	2010	Algae	*Microspora sp.*	+	<0.1
TIC1	2010-09-21	2010	Algae	*Ulotrix sp.*	+	<0.1
TIC1	2010-09-21	2010	Algae	*Oedogonium sp.*	+	<0.1
TIC1	2010-09-21	2010	Algae	*Melosira sp.*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Lythrum salicaria*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Bidens frondosa*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Iris pseudacorus*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Elodea canadensis*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Vallisneria spiralis*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Lagarosiphon major*	5	3
TIC1	2010-09-21	2010	Phanerogams	*Myriophyllum spicatum*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Elodea densa*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Carex sp.*	+	<0.1
TIC1	2010-09-21	2010	Phanerogams	*Nasturtium officinale*	+	<0.1
TIC1	2011-07-04	2011	Algae	*Cladophora* sp.	50	1
TIC1	2011-07-04	2011	Algae	*Oedogonium* sp.	15	0
TIC1	2011-07-04	2011	Algae	*Spirogyra* sp.	40	14
TIC1	2011-07-04	2011	Phanerogams	*Bidens tripartita*	+	<0.1
TIC1	2011-07-04	2011	Phanerogams	*Lagarosyphon major*	+	<0.1
TIC1	2011-07-04	2011	Phanerogams	*Lythrum salicaria*	+	<0.1
TIC1	2011-07-04	2011	Phanerogams	*Myriophyllum spicatum*	+	<0.1
TIC1	2011-07-04	2011	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC1	2011-07-04	2011	Phanerogams	*Ranunculus trychophyllus*	+	<0.1
TIC1	2011-07-04	2011	Phanerogams	*Vallisneria spiralis*	+	<0.1
TIC1	2011-09-19	2011	Algae	*Cladophora* sp.	65	39
TIC1	2011-09-19	2011	Algae	*Geminella* sp.	+	<0.1
TIC1	2011-09-19	2011	Algae	*Microspora* sp.	+	<0.1
TIC1	2011-09-19	2011	Algae	*Oedogonium* sp.	+	<0.1
TIC1	2011-09-19	2011	Algae	*Spirogyra* sp.	25	15
TIC1	2011-09-19	2011	Algae	*Ulothrix* sp.	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Carex* sp.	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Commelina communis*	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Elodea densa*	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Elodea nuttallii*	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Lagarosyphon major*	10	6
TIC1	2011-09-19	2011	Phanerogams	*Lythrum salicaria*	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Myriophyllum spicatum*	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Myriophyllum verticillatum*	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Polygonum mite*	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC1	2011-09-19	2011	Phanerogams	*Vallisneria spiralis*	+	<0.1
TIC2	2010-08-26	2010	Algae	*Cladophora* sp.	+	<0.1
TIC2	2010-08-26	2010	Algae	*Spirogyra* sp.	100	80
TIC2	2010-08-26	2010	Algae	*Chaetophora sp.*	+	<0.1
TIC2	2010-08-26	2010	Algae	*Ulotrix* sp.	+	<0.1
TIC2	2010-08-26	2010	Algae	*Oedogonium* sp.	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Rorippa amphibia*	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Lythrum salicaria*	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Elodea densa*	+	<0.1
TIC2	2010-08-26	2010	Algae	*Spirogyra* sp.	40	36
TIC2	2010-08-26	2010	Algae	*Urodema* sp.	+	<0.1
TIC2	2010-08-26	2010	Algae	*Oedogonium* sp.	+	<0.1
TIC2	2010-08-26	2010	Algae	*Melosira* sp.	+	<0.1
TIC2	2010-08-26	2010	Algae	*Phormidium* sp.	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Apium nodiflorum*	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Carex* sp.	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Polygonum mite*	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Elodea canadensis*	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Lagarosiphon major*	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Cyperus glomeratus*	+	<0.1
TIC2	2010-08-26	2010	Phanerogams	*Myosotis scorpioides*	+	<0.1
TIC2	2011-07-04	2011	Algae	*Cladophora sp.*	85	51
TIC2	2011-07-04	2011	Algae	*Oedogonium sp.*	+	<0.1

site	date	year	group	species	relative cover %	real cover %
TIC2	2011-07-04	2011	Algae	*Spirogyra sp.*	15	9
TIC2	2011-07-04	2011	Phanerogams	*Bidens tripartita*	+	<0.1
TIC2	2011-07-04	2011	Phanerogams	*Elodea densa*	+	<0.1
TIC2	2011-07-04	2011	Phanerogams	*Lagarosyphon major*	+	<0.1
TIC2	2011-07-04	2011	Phanerogams	*Myriophyllum spicatum*	+	<0.1
TIC2	2011-07-04	2011	Phanerogams	*Polygonum persicaria*	+	<0.1
TIC2	2011-07-04	2011	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC2	2011-07-04	2011	Phanerogams	*Ranunculus trychophyllus*	+	<0.1
TIC2	2011-09-19	2011	Algae	*Cladophora sp.*	85	1
TIC2	2011-09-19	2011	Algae	*Geminella sp.*	+	<0.1
TIC2	2011-09-19	2011	Algae	*Lyngbia sp.*	+	<0.1
TIC2	2011-09-19	2011	Algae	*Oedogonium sp.*	+	<0.1
TIC2	2011-09-19	2011	Algae	*Pediastrum sp.*	+	<0.1
TIC2	2011-09-19	2011	Algae	*Spirogyra sp.*	15	0
TIC2	2011-09-19	2011	Phanerogams	*Elodea canadensis*	+	<0.1
TIC2	2011-09-19	2011	Phanerogams	*Lagarosyphon major*	+	<0.1
TIC2	2011-09-19	2011	Phanerogams	*Myosotis scorpioides*	+	<0.1
TIC2	2011-09-19	2011	Phanerogams	*Myriophyllum spicatum*	+	<0.1
TIC2	2011-09-19	2011	Phanerogams	*Panicum dichotomiflorum*	+	<0.1
TIC2	2011-09-19	2011	Phanerogams	*Polygonum lapathifolium*	+	<0.1
TIC2	2011-09-19	2011	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC2	2011-09-19	2011	Phanerogams	*Vallisneria spiralis*	+	<0.1
TIC3	2010-08-25	2010	Algae	*Cladophora* sp.	55	50
TIC3	2010-08-25	2010	Algae	*Ulotrix* sp.	+	<0.1
TIC3	2010-08-25	2010	Algae	*Vaucheria* sp.	5	5
TIC3	2010-08-25	2010	Algae	*Lyngbia* sp.	+	<0.1
TIC3	2010-08-25	2010	Algae	*Microspora* sp.	+	<0.1
TIC3	2010-08-25	2010	Mosses	*Fontinalis antipyretica*	+	<0.1
TIC3	2010-08-25	2010	Phanerogams	*Rorippa amphibia*	+	<0.1
TIC3	2010-08-25	2010	Phanerogams	*Lythrum salicaria*	+	<0.1
TIC3	2010-08-25	2010	Phanerogams	*Callitriche stagnalis*	+	<0.1
TIC3	2010-08-25	2010	Phanerogams	*Vallisneria spiralis*	+	<0.1
TIC3	2010-08-25	2010	Phanerogams	*Myriophyllum spicatum*	+	<0.1
TIC3	2010-08-25	2010	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC3	2010-08-25	2010	Phanerogams	*Nasturtium officinale*	+	<0.1
TIC3	2011-07-07	2011	Algae	*Cladophora sp.*	+	<0.1
TIC3	2011-07-07	2011	Algae	*Hydrodiction sp.*	5	4
TIC3	2011-07-07	2011	Algae	*Microspora sp.*	+	<0.1
TIC3	2011-07-07	2011	Algae	*Oedogonium sp.*	85	68
TIC3	2011-07-07	2011	Algae	*Spirogyra sp.*	10	8
TIC3	2011-07-07	2011	Phanerogams	*Bidens frondosa*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Callitriche* sp.	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Elodea canadensis*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Lagarosyphon major*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Lemna minuta*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Lythrum salicaria*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Myriophyllum spicatum*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Nasturtium officinale*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Polygonum lapathifolium*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Ranunculus trychophyllus*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Rorippa amphibia*	+	<0.1
TIC3	2011-07-07	2011	Phanerogams	*Vallisneria spiralis*	+	<0.1
TIC3	2011-09-19	2011	Algae	*Cladophora sp.*	50	10
TIC3	2011-09-19	2011	Algae	*Geminella sp.*	+	<0.1
TIC3	2011-09-19	2011	Algae	*Oedogonium sp.*	+	<0.1
TIC3	2011-09-19	2011	Algae	*Oscillatoria sp.*	+	<0.1
TIC3	2011-09-19	2011	Algae	*Spirogyra sp.*	50	10
TIC3	2011-09-19	2011	Algae	*Zygnema sp.*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Callitriche sp.*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Carex sp.*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Lagarosyphon major*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Lythrum salicaria*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Myosotis scorpioides*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Myriophyllum spicatum*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Nasturtium officinale*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Panicum dichotomiflorum*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Polygonum persicaria*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Rorippa amphibia*	+	<0.1
TIC3	2011-09-19	2011	Phanerogams	*Vallisneria spiralis*	+	<0.1
TIC4	2010-08-26	2010	Algae	*Pediastrum* sp.	+	<0.1

site	date	year	group	species	relative cover %	real cover %
TIC4	2010-08-26	2010	Algae	*Cladophora* sp.	95	95
TIC4	2010-08-26	2010	Algae	*Microspora* sp.	+	<0.1
TIC4	2010-08-26	2010	Algae	*Spirogyra* sp.	+	<0.1
TIC4	2010-08-26	2010	Algae	*Hydrodiction* sp.	5	5
TIC4	2010-08-26	2010	Algae	*Oedogonium* sp.	+	<0.1
TIC4	2010-08-26	2010	Algae	*Ulotrix* sp.	+	<0.1
TIC4	2010-08-26	2010	Algae	*Melosira sp.*	+	<0.1
TIC4	2010-08-26	2010	Algae	*Tribonema sp.*	+	<0.1
TIC4	2010-08-26	2010	Algae	*Phormidium sp.*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Carex* sp.	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Potamogetum crispus*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Potamogetum perfoliatus*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Lythrum salicaria*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Lemna minor*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Elodea canadensis*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Elodea densa*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Vallisneria spiralis*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Lagarosiphon major*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Myriophyllum verticillatum*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC4	2010-08-26	2010	Phanerogams	*Polygonum* sp.	+	<0.1
TIC4	2011-07-07	2011	Algae	*Cladophora sp.*	40	32
TIC4	2011-07-07	2011	Algae	*Hydrodiction sp.*	45	36
TIC4	2011-07-07	2011	Algae	*Oedogonium sp.*	10	8
TIC4	2011-07-07	2011	Algae	*Oscillatoria sp.*	+	<0.1
TIC4	2011-07-07	2011	Algae	*Pediastrum sp.*	+	<0.1
TIC4	2011-07-07	2011	Algae	*Spirogyra sp.*	+	<0.1
TIC4	2011-07-07	2011	Algae	*Stigeoclonium sp.*	+	<0.1
TIC4	2011-07-07	2011	Phanerogams	*Elodea densa*	+	<0.1
TIC4	2011-07-07	2011	Phanerogams	*Mentha aquatica*	+	<0.1
TIC4	2011-07-07	2011	Phanerogams	*Nasturtium officinale*	+	<0.1
TIC4	2011-07-07	2011	Phanerogams	*Ranunculus fluitans*	5	4
TIC4	2011-07-07	2011	Phanerogams	*Veronica anagallis-aquatica*	+	<0.1
TIC4	2011-09-20	2011	Algae	*Cladophora sp.*	90	63
TIC4	2011-09-20	2011	Algae	*Geminella sp.*	+	<0.1
TIC4	2011-09-20	2011	Algae	*Microspora sp.*	+	<0.1
TIC4	2011-09-20	2011	Algae	*Oedogonium sp.*	+	<0.1
TIC4	2011-09-20	2011	Algae	*Spirogyra sp.*	10	7
TIC4	2011-09-20	2011	Phanerogams	*Bidens tripartita*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Carex sp.*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Cyperus strigosus*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Elodea canadensis*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Lagarosyphon major*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Lythrum salicaria*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Mentha aquatica*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Myosotis scorpioides*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Myriophyllum spicatum*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Nasturtium officinale*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Polygonum persicaria*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Ranunculus fluitans*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Ranunculus trychophyllus*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Rorippa amphibia*	+	<0.1
TIC4	2011-09-20	2011	Phanerogams	*Vallisneria spiralis*	+	<0.1

Table 39 Real and relative cover of macrophytes in Adda river in 2010 and 2011

site	date	year	group	species	relative cover %	real cover %
ADS1	2010-07-29	2010	Phanerogams	*Vallisneria spiralis*	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Typhoides arundinacea*	10	4
ADS1	2010-07-29	2010	Phanerogams	*Rorippa amphibia*	10	4
ADS1	2010-07-29	2010	Algae	*Rhizoclonium* sp.	5	2
ADS1	2010-07-29	2010	Phanerogams	*Potamogeton crispus*	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Polygonum* sp.	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Nasturtium officinale*	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Myriophyllum verticillatum*	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Myosotis scorpioides*	5	2
ADS1	2010-07-29	2010	Algae	*Microspora* sp.	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Lythrum salicaria*	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Iris pseudacorus*	+	<0.1
ADS1	2010-07-29	2010	Algae	*Hydrodictyon* sp.	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Elodea nuttallii*	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Elodea canadensis*	+	<0.1
ADS1	2010-07-29	2010	Algae	*Cladophora* sp.	70	28
ADS1	2010-07-29	2010	Phanerogams	*Ceratophyllum demersum*	+	<0.1
ADS1	2010-07-29	2010	Phanerogams	*Carex gracilis*	5	2
ADS1	2011-10-13	2011	Phanerogams	*Vallisneria spiralis*	+	<0.1
ADS1	2011-10-13	2011	Phanerogams	*Typhoides arundinacea*	+	<0.1
ADS1	2011-10-13	2011	Algae	*Spirogyra* sp.	+	<0.1
ADS1	2011-10-13	2011	Phanerogams	*Rorippa amphibia*	+	<0.1
ADS1	2011-10-13	2011	Phanerogams	*Ranunculus* sp.	+	<0.1
ADS1	2011-10-13	2011	Phanerogams	*Polygonum mite*	+	<0.1
ADS1	2011-10-13	2011	Algae	*Oedogonium* sp.	+	<0.1
ADS1	2011-10-13	2011	Phanerogams	*Nasturtium officinale*	+	<0.1
ADS1	2011-10-13	2011	Phanerogams	*Myosotis scorpioides*	+	<0.1
ADS1	2011-10-13	2011	Algae	*Microspora* sp.	+	<0.1
ADS1	2011-10-13	2011	Algae	*Cladophora* sp.	100	10
ADS1	2011-10-13	2011	Phanerogams	*Carex gracilis*	+	<0.1
ADS2	2011-08-25	2011	Algae	*Spirogyra sp.*	+	<0.1
ADS2	2011-08-25	2011	Phanerogams	*Rorippa amphibia*	+	<0.1
ADS2	2011-08-25	2011	Phanerogams	*Ranunculus trichophyllus*	+	<0.1
ADS2	2011-08-25	2011	Phanerogams	*Ranunculus fluitans*	+	<0.1
ADS2	2011-08-25	2011	Phanerogams	*Polygonum persicaria*	+	<0.1
ADS2	2011-08-25	2011	Algae	*Oedogonium sp.*	+	<0.1
ADS2	2011-08-25	2011	Phanerogams	*Myosotis scorpioides*	+	<0.1
ADS2	2011-08-25	2011	Mosses	*Fontinalis antipyretica*	100	15
ADS2	2011-08-25	2011	Phanerogams	*Elodea nuttallii*	+	<0.1
ADS2	2011-08-25	2011	Algae	*Cladophora* sp.	+	<0.1
ADS2	2011-08-25	2011	Phanerogams	*Carex gracilis*	+	<0.1
ADS2	15-29/07/2010	2010	Phanerogams	*Veronica anagallis-aquatica*	+	<0.1
ADS2	15-29/07/2010	2010	Algae	*Ulotrix* sp.	+	<0.1
ADS2	15-29/07/2010	2010	Phanerogams	*Typhoides arundinacea*	13	3.25
ADS2	15-29/07/2010	2010	Phanerogams	*Rorippa amphibia*	9	2.25
ADS2	15-29/07/2010	2010	Phanerogams	*Ranunculus trichophyllus*	3	0.75
ADS2	15-29/07/2010	2010	Mosses	*Pseudoleskeella catenulata*	+	<0.1
ADS2	15-29/07/2010	2010	Phanerogams	*Polygonum* sp.	+	<0.1
ADS2	15-29/07/2010	2010	Algae	*Oedogonium* sp.	+	<0.1
ADS2	15-29/07/2010	2010	Phanerogams	*Nasturtium officinale*	3	0.75
ADS2	15-29/07/2010	2010	Phanerogams	*Myriophyllum spicatum*	+	<0.1
ADS2	15-29/07/2010	2010	Phanerogams	*Myosotis scorpioides*	+	<0.1
ADS2	15-29/07/2010	2010	Algae	*Melosira* sp.	+	<0.1
ADS2	15-29/07/2010	2010	Mosses	*Leptodictyum riparium*	3	0.75
ADS2	15-29/07/2010	2010	Phanerogams	*Iris pseudacorus*	+	<0.1
ADS2	15-29/07/2010	2010	Mosses	*Fissidens rufulus*	+	<0.1
ADS2	15-29/07/2010	2010	Phanerogams	*Elodea canadensis*	3	0.75
ADS2	15-29/07/2010	2010	Algae	*Cladophora* sp.	60	15
ADS2	15-29/07/2010	2010	Phanerogams	*Ceratophyllum demersum*	+	<0.1
ADS2	15-29/07/2010	2010	Phanerogams	*Carex gracilis*	3	0.75
ADS2	15-29/07/2010	2010	Phanerogams	*Apium nodiflorum*	+	<0.1
ADS2	15-29/07/2010	2010	Phanerogams	*Agrostis stolonifera*	3	0.75
ADS3	2010-07-07	2010	Phanerogams	*Vallisneria spiralis*	+	<0.1

site	date	year	group	species	relative cover %	real cover %
ADS3	2010-07-07	2010	Algae	*Tribonema* sp.	+	<0.1
ADS3	2010-07-07	2010	Phanerogams	*Rorippa amphibia*	5	2.5
ADS3	2010-07-07	2010	Phanerogams	*Polygonum* sp.	+	<0.1
ADS3	2010-07-07	2010	Algae	*Pediastrum* sp.	+	<0.1
ADS3	2010-07-07	2010	Algae	*Oedogonium* sp.	40	20
ADS3	2010-07-07	2010	Phanerogams	*Nasturtium officinale*	5	2.5
ADS3	2010-07-07	2010	Phanerogams	*Myosotis scorpioides*	+	<0.1
ADS3	2010-07-07	2010	Algae	*Mougeotia* sp.	+	<0.1
ADS3	2010-07-07	2010	Algae	*Microspora* sp.	+	<0.1
ADS3	2010-07-07	2010	Algae	*Cladophora* sp.	50	25
ADS3	2010-07-07	2010	Phanerogams	*Apium nodiflorum*	+	<0.1
ADS3	2011-10-13	2011	Phanerogams	*Ranunculus fluitans*	+	<0.1
ADS3	2011-10-13	2011	Algae	*Oedogonium sp.*	+	<0.1
ADS3	2011-10-13	2011	Algae	*Microspora sp.*	30	4.5
ADS3	2011-10-13	2011	Mosses	*Fontinalis antipyretica*	+	<0.1
ADS3	2011-10-13	2011	Algae	*Cladophora* sp.	70	10.5
ADS4	2010-07-07	2010	Phanerogams	*Ranunculus tricophyllus*	+	<0.1
ADS4	2010-07-07	2010	Phanerogams	*Ranunculus fluitans*	+	<0.1
ADS4	2010-07-07	2010	Algae	*Oscillatoria* sp.	+	<0.1
ADS4	2010-07-07	2010	Algae	*Oedogonium* sp.	5	2.5
ADS4	2010-07-07	2010	Algae	*Microspora* sp.	+	<0.1
ADS4	2010-07-07	2010	Mosses	*Hygrohypnum ochraceum*	5	2.5
ADS4	2010-07-07	2010	Mosses	*Hygrohypnum luridum*	+	<0.1
ADS4	2010-07-07	2010	Mosses	*Fontinalis antipyretica*	+	<0.1
ADS4	2010-07-07	2010	Phanerogams	*Elodea canadensis*	+	<0.1
ADS4	2010-07-07	2010	Algae	*Dichotomosyphon tuberosus*	+	<0.1
ADS4	2010-07-07	2010	Algae	*Cladophora* sp.	65	32.5
ADS4	2010-07-07	2010	Phanerogams	*Ceratophyllum demersum*	+	<0.1
ADS4	2010-07-07	2010	Mosses	*Anomodon viticulosus*	20	10
ADS4	2010-07-07	2010	Mosses	*Amblystegium humile*	+	<0.1
ADS4	2010-07-07	2010	Mosses	*Amblystegium fluviatile*	5	2.5
ADS5	2010-07-09	2010	Mosses	*Rhynchostegium riparioides*	5	0.5
ADS5	2010-07-09	2010	Phanerogams	*Ranunculus fluitans*	+	<0.1
ADS5	2010-07-09	2010	Mosses	*Leptodictyum riparium*	10	1
ADS5	2010-07-09	2010	Mosses	*Fontinalis antipyretica*	10	1
ADS5	2010-07-09	2010	Algae	*Cladophora* sp.	50	5
ADS5	2010-07-09	2010	Mosses	*Cinclidotus riparius*	20	2
ADS5	2010-07-09	2010	Mosses	*Cinclidotus aquaticus*	5	0.5
ADS5	2010-07-09	2010	Phanerogams	*Apium nodiflorum*	+	<0.1
ADS6	2011-08-25	2011	Algae	*Spirogyra sp.*	+	<0.1
ADS6	2011-08-25	2011	Phanerogams	*Rorippa amphibia*	+	<0.1
ADS6	2011-08-25	2011	Algae	*Rhizoclonium sp.*	80	20
ADS6	2011-08-25	2011	Phanerogams	*Polygonum sp.*	+	<0.1
ADS6	2011-08-25	2011	Algae	*Microspora sp.*	20	5
ADS7	2010-07-09	2010	Algae	*Oedogonium* sp.	+	<0.1
ADS7	2010-07-09	2010	Algae	*Cladophora* sp.	100	5

Table 40 Absolute abundances (n° individuals / $0.5m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC1, from 2010 to 2012.

Taxon	Family	Genus	2009-12-04	2010-02-26	2010-07-06	2010-08-26	2011-02-10	2011-03-04	2011-04-07	2011-06-15	2011-09-09	2011-12-07	2012-03-13	2012-06-29
Plecoptera	Leuctridae	*Leuctra*	0	1	6	153	0	0	1	51	94	0	0	62
Ephemeroptera	Baetidae	*Baetis*	427	575	405	1800	492	158	331	754	840	436	114	416
Ephemeroptera	Caenidae	*Caenis*	107	74	0	337	214	153	614	69	102	114	48	1
Ephemeroptera	Heptageniidae	*Ecdyonurus*	104	80	2	252	104	91	113	45	60	7	1	10
Ephemeroptera	Ephemerellidae	*Ephemerella*	0	149	314	137	904	1285	2852	115	55	4	596	51
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	0	2	0	0	0	0	0	0	0	0
Trichoptera	Ecnomidae	-	0	0	0	0	0	0	0	1	7	0	0	0
Trichoptera	Goeridae	-	0	0	1	0	0	0	1	60	17	6	6	0
Trichoptera	Hydropsychidae	-	1121	713	477	3251	1105	688	484	481	2422	785	393	460
Trichoptera	Hydroptilidae	-	0	0	1	3	1	2	13	31	68	7	13	1
Trichoptera	Lepidostomatidae	-	0	1	0	9	4	2	6	4	3	3	1	4
Trichoptera	Leptoceridae	-	0	0	0	0	6	1	8	9	2	1	2	0
Trichoptera	Polycentropodidae	-	0	0	6	0	0	0	0	0	0	0	0	3
Trichoptera	Psychomyidae	-	237	114	1	31	49	40	139	28	28	189	154	34
Trichoptera	Rhyacophilidae	-	110	56	46	74	98	41	58	102	63	74	29	27
Trichoptera	Sericostomatidae	-	2	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	Dryopidae	-	0	0	0	0	2	0	0	1	0	0	0	0
Coleoptera	Dytiscidae	-	0	0	0	0	0	0	0	0	0	0	1	0
Coleoptera	Elminthidae	-	28	30	6	80	288	250	223	94	93	250	137	7
Diptera	Athericidae	-	0	0	0	2	0	0	0	0	0	0	0	0
Diptera	Chironomidae	-	61	294	25	1222	3012	5292	12995	237	630	2347	2838	56
Diptera	Dolichopodidae	-	0	0	1	0	0	0	0	0	0	0	0	0
Diptera	Empididae	-	0	1	0	1	1	3	0	8	1	0	0	0
Diptera	Limoniidae	-	0	0	0	1	9	15	3	7	11	17	10	2
Diptera	Simuliidae	-	11	155	0	192	56	1	1	7	7	32	580	8
Odonata	Gomphidae	*Onychogomphus*	2	0	0	0	11	11	15	13	6	0	1	0
Odonata	Platycnemididae	*Platycnemis*	0	0	0	0	1	0	0	0	0	0	0	0
Crustacea	Asellidae	-	3	7	11	22	10	19	47	293	4	37	1	5
Crustacea	Gammaridae	-	0	0	4	0	7	1	5	7	2	2	0	0
Gastropoda	Bythiniidae	-	0	0	0	0	0	0	0	0	0	0	0	3
Gastropoda	Hydrobioidaea	-	0	0	0	0	0	0	0	0	0	14	0	0
Gastropoda	Lymnaeidae	-	0	0	4	0	0	0	1	4	0	0	1	1
Gastropoda	Neritidae	-	0	0	0	0	0	0	1	0	1	2	1	1
Gastropoda	Physidae	-	0	0	0	0	0	0	0	1	0	1	0	0
Gastropoda	Planorbidae	-	0	0	0	0	0	1	0	2	1	0	0	0
Gastropoda	Valvatidae	-	0	0	0	0	0	0	1	1	0	0	0	1
Bivalvia	Dreissenidae	-	0	0	1	0	1	0	0	3	3	4	11	3
Bivalvia	Corbiculidae	-	0	0	1	0	0	1	0	10	9	7	0	0
Irudinea	Erpobdellidae	*Dina*	5	0	3	3	0	0	1	31	0	0	0	1
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	7	7	6	7	6	6	3	1	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	4	0	1	0	3	9	6	41	22	5	6	1
Turbellaria	Dugesiidae	*Dugesia*	4	3	5	9	44	46	16	42	66	13	1	5
Turbellaria	Planariidae	*Polycelis*	0	0	2	0	2	1	0	21	2	3	0	0
Oligocaeta	Lumbricidae	-	17	2	11	22	14	17	26	40	107	38	11	13
Oligocaeta	Lumbriculidae	-	0	0	0	0	1	1	0	0	17	1	0	0

Taxon	Family	Genus	2009-12-04	2010-02-26	2010-07-06	2010-08-26	2011-02-10	2011-03-04	2011-04-07	2011-06-15	2011-09-09	2011-12-07	2012-03-13	2012-06-29
Oligocaeta	Naididae	-	0	0	0	18	357	508	642	9	33	0	0	0
Oligocaeta	Propappidae	-	0	0	0	0	0	8	0	0	0	0	0	0
Oligocaeta	Tubificidae	-	0	0	0	0	5	0	1	0	0	0	0	0
Other taxa	Briozoa	-	1	0	0	0	0	0	0	0	0	0	0	0
Other taxa	Hydracarina	-	0	1	12	38	3	2	13	1	2	4	0	0
Other taxa	Spongillidae	-	0	0	0	0	3	0	0	0	0	0	0	0
Other taxa	Mermithidae	-	0	0	0	0	13	2	10	0	0	1	0	0
		TOT	2244	2256	1346	7666	6827	8655	18634	2629	4784	4407	4957	1176

Table 41 Absolute abundances (n° individuals / 0.5m^2) of macroinvertebrate *taxa* found in Ticino river, site TIC2, from 2010 to 2012.

Taxon	Family	Genus	2009-12-04	2010-02-25	2010-07-06	2010-08-26	2011-02-10	2011-04-07	2011-06-15	2011-09-09	2011-12-07	2012-03-13	2012-07-05
Plecoptera	Leuctridae	*Leuctra*	0	0	10	85	1	0	9	93	0	0	23
Plecoptera	Nemouridae	*Protonemura*	0	0	1	0	0	0	0	0	0	0	0
Ephemeroptera	Baetidae	*Baetis*	113	657	813	797	1155	238	1458	388	247	590	464
Ephemeroptera	Caenidae	*Caenis*	85	385	2	9	468	517	15	47	106	57	12
Ephemeroptera	Heptageniidae	*Ecdyonurus*	93	53	20	78	75	18	32	37	7	14	0
Ephemeroptera	Heptageniidae	*Electrogena*	0	1	0	0	0	0	0	0	0	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	1	422	500	1	356	2612	32	10	0	342	44
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	0	2	0	1	4	0	0	0	0
Trichoptera	Brachycentridae	-	0	0	0	0	2	0	0	0	0	0	0
Trichoptera	Ecnomidae	-	0	0	0	0	0	0	2	0	0	0	0
Trichoptera	Goeridae	-	0	0	0	0	0	5	2	2	0	2	0
Trichoptera	Hydropsychidae	-	2000	1035	611	839	1731	1029	744	1069	897	1025	290
Trichoptera	Hydroptilidae	-	2	0	1	11	3	51	1	92	7	4	1
Trichoptera	Lepidostomatidae	-	3	4	2	0	14	17	7	8	2	10	2
Trichoptera	Leptoceridae	-	0	4	2	4	2	11	1	0	0	2	1
Trichoptera	Limnephilidae	-	0	0	1	0	0	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	243	533	16	48	141	135	0	92	201	282	154
Trichoptera	Rhyacophilidae	-	70	38	35	22	104	105	132	30	25	59	15
Coleoptera	Elminthidae	-	4	69	14	56	173	149	29	85	59	83	25
Diptera	Anthomyidae/Muscidae	-	0	0	1	0	0	0	0	0	0	0	0
Diptera	Chironomidae	-	55	1131	70	685	2340	2421	123	256	677	550	109
Diptera	Empididae	-	0	0	0	0	0	0	1	0	0	0	0
Diptera	Limoniidae	-	0	0	0	0	3	7	0	4	2	6	27
Diptera	Simuliidae	-	5	80	0	23	32	1	26	19	43	48	8
Odonata	Calopterygidae	*Calopteryx*	1	0	0	0	0	0	0	0	0	0	0
Odonata	Gomphidae	*Gomphus*	2	0	0	0	0	0	0	0	0	0	0
Odonata	Gomphidae	*Onychogomphus*	0	2	6	1	4	23	1	14	1	9	7
Crustacea	Asellidae	-	0	6	2	3	0	1	4	7	1	13	8
Crustacea	Gammaridae	-	0	0	1	0	0	0	3	0	0	1	0
Gastropoda	Ancylidae	-	0	0	4	0	0	0	0	3	0	4	10
Gastropoda	Bythiniidae	-	0	0	0	0	1	1	0	1	0	0	0
Gastropoda	Lymnaeidae	-	0	1	0	0	0	0	0	0	0	2	4
Gastropoda	Neritidae	-	0	1	0	0	0	5	0	6	1	4	17
Gastropoda	Physidae	-	0	1	0	1	3	1	0	2	0	1	1

Taxon	Family	Genus	2009-12-04	2010-02-25	2010-07-06	2010-08-26	2011-02-10	2011-04-07	2011-06-15	2011-09-09	2011-12-07	2012-03-13	2012-07-05
Gastropoda	Valvatidae	-	0	0	0	1	0	0	0	0	0	0	0
Bivalvia	Dreissenidae	-	0	0	0	0	0	0	0	3	0	4	2
Bivalvia	Corbiculidae	-	0	0	0	1	0	3	0	11	1	3	0
Irudinea	Erpobdellidae	*Dina*	0	0	6	1	0	0	1	0	0	0	0
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	0	0	0	1	1	2	0	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	2	3	2	4	6	6	2	0	0	6	1
Turbellaria	Dugesiidae	*Dugesia*	10	6	4	93	36	21	0	46	8	34	9
Turbellaria	Planariidae	*Polycelis*	0	0	0	0	0	0	0	0	0	0	2
Oligocaeta	Enchytraeidae	-	0	1	0	0	0	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	6	1	11	14	12	18	10	59	6	18	7
Oligocaeta	Lumbriculidae	-	0	0	0	0	2	0	0	0	0	0	1
Oligocaeta	Naididae	-	7	9	4	24	358	1100	1	0	0	2	0
Oligocaeta	Tubificidae	-	0	0	0	2	3	0	0	0	0	0	0
Other taxa	Briozoa	-	0	0	0	0	0	1	0	0	0	0	0
Other taxa	Hydracarina	-	0	0	4	5	8	16	1	3	0	0	0
Other taxa	Mermithidae	-	1	0	0	1	11	7	1	0	0	1	0
		TOT	2703	4443	2143	2811	7044	8520	2643	2388	2293	3176	1244

Table 42 Absolute abundances (n° individuals / 0.5m^2) of macroinvertebrate *taxa* found in Ticino river, site TIC3, from 2010 to 2012.

Taxon	Family	Genus	2009-12-04	2010-02-25	2010-07-06	2010-08-25	2011-02-10	2011-04-07	2011-06-15	2011-09-16	2011-12-07	2012-03-20	2012-06-29
Plecoptera	Leuctridae	*Leuctra*	2	1	47	92	0	0	156	42	0	0	113
Plecoptera	Nemouridae	*Nemoura*	0	1	0	0	0	0	0	0	0	0	0
Plecoptera	Perlodidae	*Perlodes/Besdolus*	0	2	0	0	0	0	0	0	0	0	0
Ephemeroptera	Baetidae	*Baetis*	414	1300	104	1110	565	176	1174	318	224	218	769
Ephemeroptera	Caenidae	*Caenis*	57	388	0	231	368	37	9	23	172	0	2
Ephemeroptera	Heptageniidae	*Ecdyonurus*	114	227	7	159	49	65	26	3	12	17	30
Ephemeroptera	Heptageniidae	*Electrogena*	2	6	0	0	0	0	0	0	0	0	0
Ephemeroptera	Ephemeridae	*Ephemera*	0	0	0	0	0	0	1	0	0	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	2	399	12	69	1024	1558	46	4	0	405	106
Ephemeroptera	Heptageniidae	*Heptagenia*	1	6	0	10	1	0	3	0	0	0	0
Ephemeroptera	Heptageniidae	*Rhithrogena*	0	1	0	0	0	0	0	0	0	0	0
Trichoptera	Ecnomidae	-	0	0	0	0	1	0	1	0	0	0	0
Trichoptera	Goeridae	-	0	0	0	1	1	0	0	3	0	0	2
Trichoptera	Hydropsychidae	-	394	530	34	1238	530	964	292	629	827	329	797
Trichoptera	Hydroptilidae	-	1	10	0	30	7	20	25	40	15	0	6
Trichoptera	Lepidostomatidae	-	15	20	0	0	4	2	3	4	0	1	0
Trichoptera	Leptoceridae	-	0	0	0	11	28	11	9	1	9	0	0
Trichoptera	Philopotamidae	-	1	0	0	0	0	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	400	631	1	117	57	92	46	18	51	112	55
Trichoptera	Rhyacophilidae	-	25	48	2	48	46	45	102	8	33	27	53
Trichoptera	Sericostomatidae	-	1	0	0	0	0	0	0	0	0	0	0
Coleoptera	Dryopidae	-	0	0	0	1	0	0	0	0	2	0	0
Coleoptera	Elminthidae	-	2	16	0	41	103	29	46	55	66	33	19
Diptera	Ceratopogonidae	-	0	0	0	0	0	0	2	0	0	0	0
Diptera	Chironomidae	-	22	478	9	365	1371	728	1720	151	432	471	55

Taxon	Family	Genus	2009-12-04	2010-02-25	2010-07-06	2010-08-25	2011-02-10	2011-04-07	2011-06-15	2011-09-16	2011-12-07	2012-03-20	2012-06-29
Diptera	Empididae	-	0	1	0	2	0	1	8	1	0	0	1
Diptera	Limoniidae	-	3	12	0	2	12	13	53	8	12	47	26
Diptera	Simuliidae	-	23	93	0	143	74	0	3	42	38	23	78
Diptera	Tabanidae	-	0	0	1	0	0	0	0	0	0	2	0
Odonata	Calopterygidae	*Calopteryx*	2	0	0	1	0	0	0	0	0	0	0
Odonata	Gomphidae	*Gomphus*	0	3	0	0	0	0	0	0	0	0	0
Odonata	Gomphidae	*Onychogomphus*	12	0	0	2	3	2	7	3	0	5	0
Crustacea	Asellidae	-	0	0	0	1	3	1	3	0	1	0	7
Crustacea	Gammaridae	-	1	26	5	2	1	0	3	1	0	59	3
Gastropoda	Ancylidae	-	0	0	0	0	0	0	0	0	0	0	4
Gastropoda	Bythiniidae	-	0	0	0	1	1	2	1	4	0	0	0
Gastropoda	Lymnaeidae	-	0	0	0	0	4	1	1	0	1	0	1
Gastropoda	Neritidae	-	0	0	0	26	5	1	3	11	4	21	16
Gastropoda	Planorbidae	-	0	0	0	0	0	0	0	0	1	0	1
Gastropoda	Valvatidae	-	0	0	0	0	5	0	0	0	4	0	1
Bivalvia	Dreissenidae	-	0	0	0	0	0	1	0	1	1	0	0
Bivalvia	Pisidiidae	-	0	0	0	0	1	0	0	0	0	0	0
Bivalvia	Corbiculidae	-	0	0	0	2	2	1	4	7	3	0	3
Irudinea	Erpobdellidae	*Dina*	0	1	1	1	0	5	0	0	1	0	1
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	0	0	0	0	4	0	0	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	0	0	0	0	1	0	0	0	0	0	2
Turbellaria	Dugesiidae	*Dugesia*	2	2	0	11	1	0	1	18	5	0	9
Oligocaeta	Enchytraeidae	-	0	0	0	1	4	0	0	0	1	0	0
Oligocaeta	Haplotaxidae	-	0	0	2	0	0	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	1	5	3	27	25	15	37	42	18	0	28
Oligocaeta	Lumbriculidae	-	0	0	0	1	1	0	0	0	0	0	0
Oligocaeta	Naididae	-	1	68	0	2	25	0	0	0	1	0	0
Other taxa	Hydracarina	-	0	0	0	22	8	0	5	1	0	0	0
Other taxa	Mermithidae	-	0	0	0	1	5	1	0	0	0	0	0
		TOT	1498	4275	228	3771	4336	3771	3790	1442	1934	1770	2188

Table 43 Absolute abundances (n° individuals / $0.5m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC4, from 2010 to 2012.

Taxon	Family	Genus	2009-12-04	2010-02-25	2010-07-06	2010-08-26	2011-02-10	2011-03-04	2011-04-07	2011-06-15	2011-09-09	2011-12-07	2012-03-13	2012-06-29
Plecoptera	Leuctridae	*Leuctra*	0	0	9	6	0	0	3	156	173	0	0	176
Ephemeroptera	Baetidae	*Baetis*	30	75	475	68	70	72	424	1264	647	332	140	590
Ephemeroptera	Caenidae	*Caenis*	823	329	5	34	445	595	87	7	621	122	29	15
Ephemeroptera	Heptageniidae	*Ecdyonurus*	89	4	39	7	10	13	145	44	13	11	17	126
Ephemeroptera	Ephemerellidae	*Ephemerella*	1	77	230	1	250	678	1029	43	10	0	377	323
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	0	0	1	1	0	2	0	0	0	0
Trichoptera	Ecnomidae	-	0	0	0	0	0	3	0	37	3	0	0	0
Trichoptera	Goeridae	-	0	0	0	2	0	1	0	0	3	1	0	1
Trichoptera	Hydropsychidae	-	883	316	142	99	517	761	156	537	971	1467	390	181
Trichoptera	Hydroptilidae	-	0	10	3	67	5	10	4	3	44	0	1	0
Trichoptera	Lepidostomatidae	-	3	0	6	5	13	13	1	5	12	0	0	4
Trichoptera	Leptoceridae	-	9	3	0	19	10	8	3	0	5	1	0	0

Taxon	Family	Genus	2009-12-04	2010-02-25	2010-07-06	2010-08-26	2011-02-10	2011-03-04	2011-04-07	2011-06-15	2011-09-09	2011-12-07	2012-03-13	2012-06-29
Trichoptera	Limnephilidae	-	0	1	0	0	3	0	0	0	0	0	0	0
Trichoptera	Odontoceridae	-	0	0	0	1	0	1	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	579	766	80	57	463	829	19	67	44	43	40	27
Trichoptera	Rhyacophilidae	-	5	42	7	4	21	21	20	34	3	8	12	9
Coleoptera	Dryopidae	-	0	0	0	10	11	15	0	0	0	0	1	0
Coleoptera	Elminthidae	-	3	20	8	5	73	50	41	19	33	27	5	7
Coleoptera	Gyrinidae	-	0	0	0	0	1	0	0	0	0	0	0	0
Coleoptera	Hydrophilidae	-	0	0	0	2	0	0	0	0	0	0	0	0
Diptera	Ceratopogonidae	-	0	0	0	13	0	0	0	0	0	0	0	0
Diptera	Chironomidae	-	162	2665	287	1265	2165	2170	2535	1533	1264	2698	1001	94
Diptera	Empididae	-	0	2	0	0	2	5	0	1	0	0	0	0
Diptera	Limoniidae	-	0	8	5	0	22	37	0	3	1	0	3	0
Diptera	Simuliidae	-	0	6	4	1	16	7	12	8	4	182	122	7
Diptera	Tabanidae	-	1	1	0	0	0	0	1	0	1	0	0	0
Diptera	Tipulidae	-	0	0	1	0	0	0	0	1	0	1	0	1
Odonata	Calopterygidae	*Calopteryx*	0	1	0	2	0	0	0	0	0	0	0	0
Odonata	Gomphidae	*Gomphus*	0	1	0	0	0	0	0	0	0	0	0	0
Odonata	Gomphidae	*Onychogomphus*	11	1	0	0	3	12	0	2	5	0	0	0
Crustacea	Asellidae	-	0	0	7	1	1	0	2	4	10	0	0	0
Crustacea	Gammaridae	-	45	365	52	58	104	161	51	220	6	3	3	14
Gastropoda	Ancylidae	-	0	1	0	0	0	0	0	0	0	0	0	1
Gastropoda	Bythiniidae	-	0	0	0	4	1	0	0	0	0	0	0	0
Gastropoda	Lymnaeidae	-	0	0	1	16	4	3	0	1	0	0	0	1
Gastropoda	Neritidae	-	0	0	0	1	0	0	0	0	0	0	0	0
Gastropoda	Physidae	-	0	1	0	4	3	2	0	1	0	0	0	0
Gastropoda	Planorbidae	-	0	0	0	4	0	1	0	0	0	1	0	2
Gastropoda	Valvatidae	-	0	0	0	0	0	0	0	0	0	2	0	0
Bivalvia	Pisidiidae	-	0	0	0	1	0	0	0	0	0	0	0	0
Bivalvia	Sphaeriidae	-	0	2	0	0	1	0	0	0	0	0	0	0
Bivalvia	Corbiculidae	-	0	0	0	1	0	1	0	1	0	2	0	0
Irudinei	Erpobdellidae	*Dina*	0	0	0	0	0	0	0	0	0	0	1	1
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	1	0	1	0	0	2	0	1	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	0	1	0	0	0	0	0	1	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	3	3	0	9	58	111	3	15	58	5	5	7
Oligocaeta	Enchytraeidae	-	0	1	2	9	10	12	2	1	1	0	0	0
Oligocaeta	Haplotaxidae	-	0	1	0	0	0	0	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	2	10	0	26	54	96	0	0	30	4	7	8
Oligocaeta	Lumbriculidae	-	0	2	0	0	17	19	5	2	2	0	0	1
Oligocaeta	Naididae	-	7	99	28	223	124	480	316	26	12	3	17	0
Oligocaeta	Propappidae	-	0	0	0	0	2	0	0	0	0	0	0	0
Oligocaeta	Tubificidae	-	0	0	0	0	1	0	0	0	0	0	0	0
Other taxa	Hydracarina	-	0	12	8	8	19	26	0	8	3	0	0	0
Other taxa	Mermithidae	-	0	4	0	0	12	13	0	0	0	0	0	0
		TOT	2656	4830	1399	2034	4512	6228	4859	4046	3981	4913	2172	1596

Table 44 Absolute abundances (n° individuals / $0.5m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS1, from 2010 to 2012.

Taxon	**Family**	**Genus**	**2009-12-17**	**2010-04-22**	**2010-09-03**	**2011-01-17**	**2011-03-30**	**2011-08-23**	**2011-12-13**	**2012-03-16**	**2012-07-05**
Plecoptera	Leuctridae	*Leuctra*	0	1	7	0	1	31	0	0	19
Ephemeroptera	Baetidae	*Baetis*	410	271	231	216	1168	39	141	386	61
Ephemeroptera	Caenidae	*Caenis*	249	177	37	132	116	54	96	120	10
Ephemeroptera	Heptageniidae	*Ecdyonurus*	15	76	7	33	62	11	15	24	0
Ephemeroptera	Heptageniidae	*Electrogena*	1	0	0	0	0	0	0	0	0
Ephemeroptera	Ephemeridae	*Ephemera*	0	0	2	0	1	1	1	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	10	2255	53	15	5691	3	6	307	18
Ephemeroptera	Heptageniidae	*Heptagenia*	3	2	4	0	0	1	0	0	0
Ephemeroptera	Potamanthidae	*Potamanthus*	0	0	0	0	0	0	0	0	1
Trichoptera	Ecnomidae	-	0	0	7	0	0	0	0	0	0
Trichoptera	Glossosomatidae	-	0	0	0	0	0	0	0	0	1
Trichoptera	Goeridae	-	34	11	11	0	1	2	2	8	10
Trichoptera	Hydropsychidae	-	2102	752	1317	1458	1896	905	1811	1018	320
Trichoptera	Hydroptilidae	-	214	226	13	38	34	7	31	73	8
Trichoptera	Lepidostomatidae	-	7	2	2	0	1	0	0	0	3
Trichoptera	Leptoceridae	-	1	9	6	0	2	1	5	5	1
Trichoptera	Limnephilidae	-	0	0	0	4	0	3	1	1	0
Trichoptera	Polycentropodidae	-	0	0	10	0	0	6	0	0	69
Trichoptera	Psychomyidae	-	45	260	37	2	26	2	5	22	1
Trichoptera	Rhyacophilidae	-	222	81	9	63	133	12	97	103	14
Coleoptera	Elminthidae	-	397	103	81	90	197	78	251	169	45
Coleoptera	Gyrinidae	-	1	0	0	6	0	0	15	2	0
Diptera	Athericidae	-	3	0	0	0	0	0	2	0	0
Diptera	Chironomidae	-	198	2171	360	149	6631	36	245	1079	17
Diptera	Empididae	-	2	4	0	0	1	0	1	6	1
Diptera	Limoniidae	-	60	296	38	124	195	3	103	403	23
Diptera	Psychodidae	-	0	0	0	0	0	0	2	0	0
Diptera	Simuliidae	-	110	13	246	103	13	8	70	43	29
Diptera	Tipulidae	-	0	0	0	1	0	0	0	1	5
Odonata	Calopterygidae	*Calopteryx*	0	0	1	5	0	4	1	0	0
Odonata	Gomphidae	*Onychogomphus*	2	2	6	2	1	5	0	1	3
Eteroptera	Aphelocheiridae	-	0	0	13	22	1	7	0	4	0
Eteroptera	Naucoridae	-	2	0	0	0	0	0	0	0	7
Crustacea	Asellidae	-	0	0	3	0	2	0	4	29	18
Crustacea	Gammaridae	-	8	1	54	27	15	42	0	1	18
Gastropoda	Ancylidae	-	12	18	30	3	19	4	0	12	1
Gastropoda	Bythiniidae	-	7	23	419	23	110	54	69	54	16
Gastropoda	Lymnaeidae	-	4	1	16	6	7	0	1	14	66
Gastropoda	Neritidae	-	215	124	165	798	208	364	377	222	86
Gastropoda	Physidae	-	0	0	0	0	0	1	0	0	1
Gastropoda	Planorbidae	-	0	3	4	8	1	1	1	0	20
Gastropoda	Valvatidae	-	0	0	4	0	0	3	0	0	4
Bivalvia	Dreissenidae	-	111	32	19	3	18	3	26	36	0
Bivalvia	Pisidiidae	-	0	0	8	1	0	2	0	6	0
Irudinea	Erpobdellidae	*Dina*	0	0	1	0	0	1	0	0	0
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	0	0	0	1	0	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	0	0	2	0	6	1	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	4	17	6	28	28	6	107	84	3
Turbellaria	Planariidae	*Polycelis*	0	0	0	0	0	0	0	0	1
Oligocaeta	Enchytraeidae	-	2	0	1	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	7	4	13	14	28	39	13	24	27
Oligocaeta	Lumbriculidae	-	0	7	3	1	48	10	0	0	0
Oligocaeta	Naididae	-	1	3	1	6	34	1	0	2	0
Oligocaeta	Tubificidae	-	1	10	3	0	1	0	0	0	0
Other taxa	Hydracarina	-	3	27	24	1	19	1	0	4	0
Other taxa	Mermithidae	-	4	0	0	6	5	0	0	0	0
		TOT	4467	6982	3274	3388	16720	1752	3500	4263	927

Table 45 Absolute abundances (n° individuals / $0.5m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS2, from 2010 to 2012.

Taxon	Family	Genus	2009-12-17	2010-04-22	2010-09-03	2011-01-17	2011-04-08	2011-08-23	2011-12-13	2012-03-16	2012-06-22
Plecoptera	Nemouridae	*Amphinemura*	0	0	1	0	0	0	0	0	0
Plecoptera	Leuctridae	*Leuctra*	1	0	17	2	0	61	0	0	6
Ephemeroptera	Baetidae	*Baetis*	184	160	485	628	323	598	145	166	69
Ephemeroptera	Caenidae	*Caenis*	99	145	55	59	104	117	38	55	35
Ephemeroptera	Heptageniidae	*Ecdyonurus*	16	49	3	20	40	33	10	16	4
Ephemeroptera	Ephemeridae	*Ephemera*	1	0	0	0	0	0	0	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	9	775	41	53	1208	58	3	93	69
Ephemeroptera	Heptageniidae	*Heptagenia*	4	7	5	7	5	8	1	1	0
Ephemeroptera	Oligoneuriidae	*Oligoneuriella*	0	11	0	0	0	0	0	0	0
Ephemeroptera	Potamanthidae	*Potamanthus*	0	0	0	1	0	0	0	0	0
Trichoptera	Glossosomatidae	-	0	13	0	0	0	0	0	0	0
Trichoptera	Goeridae	-	10	11	0	6	3	18	0	3	4
Trichoptera	Hydropsychidae	-	1246	1012	930	1614	1198	1785	737	445	369
Trichoptera	Hydroptilidae	-	65	198	4	41	133	47	101	25	16
Trichoptera	Lepidostomatidae	-	163	5	1	20	6	12	21	3	3
Trichoptera	Leptoceridae	-	1	1	1	11	6	2	13	7	1
Trichoptera	Limnephilidae	-	0	0	4	0	1	1	0	0	4
Trichoptera	Philopotamidae	-	0	0	0	1	0	0	0	0	0
Trichoptera	Polycentropodidae	-	0	0	0	1	0	0	1	0	0
Trichoptera	Psychomyidae	-	207	775	107	287	605	174	229	161	1
Trichoptera	Rhyacophilidae	-	46	26	49	83	28	56	29	24	22
Trichoptera	Sericostomatidae	-	0	0	0	1	0	0	0	0	0
Coleoptera	Dytiscidae	-	1	0	0	0	0	0	0	0	0
Coleoptera	Elminthidae	-	301	456	167	445	480	261	411	129	146
Coleoptera	Gyrinidae	-	0	0	0	1	1	1	7	1	0
Diptera	Athericidae	-	0	0	1	0	0	1	1	0	0
Diptera	Ceratopogonidae	-	0	0	0	0	0	0	0	1	0
Diptera	Chironomidae	-	150	6209	92	381	4257	106	470	586	32
Diptera	Empididae	-	2	2	0	1	11	1	2	4	5
Diptera	Limoniidae	-	28	53	8	58	145	120	134	46	31
Diptera	Psychodidae	-	0	47	0	0	0	0	0	0	4
Diptera	Simuliidae	-	76	14	577	51	6	516	335	41	7
Diptera	Tipulidae	-	0	0	0	0	0	0	0	0	2
Odonata	Calopterygidae	*Calopteryx*	1	0	1	0	0	2	0	3	1
Odonata	Gomphidae	*Onychogomphus*	0	0	0	0	0	1	2	1	0
Eteroptera	Aphelocheiridae	-	1	0	0	5	4	19	7	1	9
Crustacea	Asellidae	-	0	0	1	4	1	3	1	2	41
Crustacea	Gammaridae	-	78	31	18	45	23	59	9	6	241
Gastropoda	Ancylidae	-	100	321	22	208	142	46	8	9	1
Gastropoda	Bythiniidae	-	2	0	2	4	3	269	9	17	117
Gastropoda	Hydrobioidaea	-	0	0	0	0	0	0	1	0	0
Gastropoda	Lymnaeidae	-	0	0	1	2	1	22	3	1	173
Gastropoda	Neritidae	-	11	30	20	45	117	379	130	36	22
Gastropoda	Physidae	-	1	1	0	0	0	2	0	0	0
Gastropoda	Planorbidae	-	0	0	0	0	0	3	0	1	5
Gastropoda	Valvatidae	-	0	0	0	0	0	3	0	0	14
Bivalvia	Dreissenidae	-	75	71	26	11	7	31	19	3	11
Bivalvia	Pisidiidae	-	0	0	0	0	0	1	3	0	4
Bivalvia	Sphaeriidae	-	0	0	0	0	0	0	0	0	2
Bivalvia	Corbiculidae	-	0	0	0	1	1	13	0	0	2
Irudinea	Erpobdellidae	*Dina*	0	0	1	0	0	0	0	1	2
Turbellaria	Dendrocoelidae	*Dendrocoelum*	0	0	1	0	0	0	0	2	0
Turbellaria	Dugesiidae	*Dugesia*	8	5	3	83	42	118	136	16	8
Oligocaeta	Enchytraeidae	-	0	0	0	0	0	0	1	0	0
Oligocaeta	Haplotaxidae	-	0	0	0	0	2	0	0	0	0
Oligocaeta	Lumbricidae	-	22	8	62	81	17	127	36	14	45
Oligocaeta	Lumbriculidae	-	0	1	0	3	8	67	3	1	0
Oligocaeta	Naididae	-	1	17	0	23	527	0	1	48	0
Oligocaeta	Propappidae	-	0	0	0	1	2	0	0	0	0
Oligocaeta	Tubificidae	-	0	0	0	1	0	0	0	0	0
Other taxa	Hydracarina	-	0	11	3	20	21	5	0	19	1
Other taxa	Curbiculidae	-	1	0	1	0	0	0	0	0	0
Other taxa	Mermithidae	-	1	32	8	6	4	3	0	2	0
		TOT	2912	10497	2718	4315	9482	5149	3057	1990	1529

Table 46 Absolute abundances (n° individuals / 0.5m^2) of macroinvertebrate *taxa* found in Adda river, site ADS3, from 2010 to 2012.

Taxon	Family	Genus	2010-01-07	2010-04-22	2010-09-03	2011-01-17	2011-04-08	2011-08-23	2011-12-13	2012-03-13	2012-06-22
Plecoptera	Leuctridae	*Leuctra*	1	6	7	0	23	46	1	1	3
Ephemeroptera	Baetidae	*Baetis*	301	323	472	187	554	507	93	536	54
Ephemeroptera	Caenidae	*Caenis*	147	369	62	5	63	85	27	70	9
Ephemeroptera	Heptageniidae	*Ecdyonurus*	7	65	16	5	22	36	17	53	22
Ephemeroptera	Ephemeridae	*Ephemera*	8	2	0	0	0	0	0	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	5	971	25	4	1138	210	47	226	155
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	7	0	0	1	0	0	0
Ephemeroptera	Oligoneuriidae	*Oligoneuriella*	0	4	1	0	0	0	0	1	0
Ephemeroptera	Potamanthidae	*Potamanthus*	0	3	0	0	0	0	0	0	0
Trichoptera	Goeridae	-	0	2	0	0	0	1	0	2	0
Trichoptera	Hydropsychidae	-	1497	936	283	3	27	728	51	304	9
Trichoptera	Hydroptilidae	-	9	23	12	23	63	172	1	144	2
Trichoptera	Lepidostomatidae	-	0	0	1	0	1	5	1	1	0
Trichoptera	Leptoceridae	-	2	0	0	0	1	1	0	0	0
Trichoptera	Limnephilidae	-	0	0	0	0	2	2	0	0	0
Trichoptera	Psychomyidae	-	7	15	51	48	372	263	149	6	1
Trichoptera	Rhyacophilidae	-	74	56	10	24	82	29	30	69	12
Trichoptera	Sericostomatidae	-	1	0	0	0	0	0	0	0	0
Coleoptera	Dryopidae	-	1	1	0	0	1	0	0	0	1
Coleoptera	Elminthidae	-	74	110	53	9	35	26	18	17	6
Coleoptera	Gyrinidae	-	1	0	0	0	0	0	1	3	0
Diptera	Muscidae	-	7	0	0	0	0	0	0	0	0
Diptera	Athericidae	-	2	1	0	0	0	0	0	0	0
Diptera	Ceratopogonidae	-	0	1	0	0	0	0	0	0	0
Diptera	Chironomidae	-	62	683	287	728	15410	286	940	1092	220
Diptera	Empididae	-	0	48	1	0	15	0	0	0	0
Diptera	Limoniidae	-	10	27	1	92	338	156	18	68	1
Diptera	Psychodidae	-	0	80	0	0	0	0	0	0	0
Diptera	Simuliidae	-	544	79	862	108	64	125	198	40	3
Diptera	Tipulidae	-	12	2	0	0	0	0	0	1	0
Eteroptera	Aphelocheiridae	-	0	0	1	0	0	0	0	2	0
Eteroptera	Naucoridae	-	2	0	0	0	0	0	0	0	0
Crustacea	Asellidae	-	2	0	0	0	2	1	2	1	2
Crustacea	Gammaridae	-	50	79	6	3	25	24	11	21	41
Gastropoda	Ancylidae	-	55	28	2	0	13	127	3	2	11
Gastropoda	Bythiniidae	-	0	8	7	0	0	30	0	0	0
Gastropoda	Lymnaeidae	-	44	7	5	0	0	0	0	0	1
Gastropoda	Neritidae	-	36	9	56	0	1	88	1	15	5
Gastropoda	Physidae	-	11	0	1	0	0	0	0	2	0
Gastropoda	Planorbidae	-	7	0	3	0	0	1	0	0	0
Gastropoda	Valvatidae	-	0	0	1	0	0	0	0	0	0
Bivalvia	Dreissenidae	-	1	0	1	0	0	2	0	0	0
Irudinea	Erpobdellidae	*Dina*	7	2	2	0	0	0	0	0	2
Irudinea	Erpobdellidae	*Erpobdella*	0	0	1	0	0	1	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	0	4	0	0	0	25	2	0	1
Turbellaria	Planariidae	*Polycelis*	0	0	0	0	1	0	0	0	0
Oligocaeta	Enchytraeidae	-	0	0	0	0	6	0	0	0	0
Oligocaeta	Haplotaxidae	-	0	0	0	0	0	0	1	0	0
Oligocaeta	Lumbricidae	-	121	122	57	1	12	44	2	0	22
Oligocaeta	Lumbriculidae	-	0	4	0	0	30	3	3	0	0
Oligocaeta	Naididae	-	0	2	0	12	4682	0	15	0	0
Oligocaeta	Propappidae	-	0	2	0	0	2	0	0	0	0
Oligocaeta	Tubificidae	-	0	0	1	0	13	0	0	0	0
Other taxa	Hydracarina	-	0	0	3	0	0	1	0	5	0
Other taxa	Mermithidae	-	0	0	1	10	53	1	6	0	0
		TOT	3108	4074	2299	1262	23051	3027	1638	2682	583

Table 47 Absolute abundances (n° individuals / $0.5m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS4, from 2010 to 2012.

Taxon	Family	Genus	2010-01-07	2010-04-22	2010-09-03	2011-01-14	2011-04-08	2011-08-24	2011-12-14	2012-03-13	2012-06-22
Plecoptera	Nemouridae	*Amphinemura*	0	1	0	0	0	0	0	0	0
Plecoptera	Taeniopterygidae	*Brachyptera*	0	0	0	0	0	0	0	1	0
Plecoptera	Leuctridae	*Leuctra*	1	5	3	3	11	12	0	0	25
Ephemeroptera	Baetidae	*Baetis*	329	362	1450	108	835	249	230	915	342
Ephemeroptera	Caenidae	*Caenis*	50	170	55	5	25	46	0	10	19
Ephemeroptera	Heptageniidae	*Ecdyonurus*	50	52	29	11	90	11	8	60	27
Ephemeroptera	Heptageniidae	*Electrogena*	3	0	0	0	0	0	0	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	14	873	18	10	1129	35	16	2355	103
Ephemeroptera	Heptageniidae	*Heptagenia*	10	8	13	3	2	2	0	0	1
Ephemeroptera	Oligoneuriidae	*Oligoneuriella*	0	11	0	0	2	0	0	0	5
Ephemeroptera	Potamanthidae	*Potamanthus*	0	1	0	0	0	0	0	0	0
Trichoptera	Ecnomidae	-	0	0	7	0	0	0	0	0	0
Trichoptera	Glossosomatidae	-	0	37	36	0	2	54	1	1	0
Trichoptera	Goeridae	-	1	1	1	0	1	0	0	0	0
Trichoptera	Hydropsychidae	-	71	117	196	70	37	325	62	109	69
Trichoptera	Hydroptilidae	-	1	97	12	0	18	9	0	53	7
Trichoptera	Lepidostomatidae	-	0	0	0	1	0	0	1	1	0
Trichoptera	Leptoceridae	-	0	2	1	0	0	0	0	0	0
Trichoptera	Limnephilidae	-	2	0	0	0	0	0	0	0	0
Trichoptera	Polycentropodidae	-	0	0	2	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	5	9	4	3	33	18	29	26	4
Trichoptera	Rhyacophilidae	-	20	9	7	52	83	15	54	60	56
Coleoptera	Dryopidae	-	0	2	0	0	0	0	0	0	0
Coleoptera	Elminthidae	-	115	266	28	40	26	5	23	117	22
Coleoptera	Gyrinidae	-	0	2	0	0	2	0	0	1	0
Coleoptera	Haliplidae	-	0	0	0	1	0	0	0	0	0
Diptera	Athericidae	-	0	0	1	0	0	2	0	0	0
Diptera	Ceratopogonidae	-	0	0	0	0	0	0	0	3	0
Diptera	Chironomidae	-	56	644	331	320	1898	15	440	1142	63
Diptera	Empididae	-	1	8	0	0	19	0	0	1	0
Diptera	Limoniidae	-	3	20	0	7	11	0	3	10	0
Diptera	Psychodidae	-	0	3	0	0	0	0	0	0	0
Diptera	Simuliidae	-	281	108	329	32	27	479	283	54	84
Diptera	Tabanidae	-	0	1	0	0	0	0	0	2	0
Diptera	Tipulidae	-	6	0	0	0	0	0	0	0	1
Odonata	Gomphidae	*Onychogomphus*	1	0	0	0	0	0	0	0	0
Eteroptera	Aphelocheiridae	-	0	0	0	1	0	1	0	1	0
Crustacea	Asellidae	-	0	0	0	1	0	0	0	0	0
Crustacea	Atyidae	-	0	0	0	0	0	0	1	0	0
Crustacea	Gammaridae	-	18	42	14	31	22	10	8	14	29
Crustacea	Niphargidae	-	1	0	0	0	0	0	0	0	0
Gastropoda	Ancylidae	-	1	3	0	1	0	2	0	0	1
Gastropoda	Bythiniidae	-	1	1	0	0	1	1	1	0	1
Gastropoda	Lymnaeidae	-	0	1	0	0	0	0	0	0	0
Gastropoda	Neritidae	-	6	6	2	6	0	3	3	3	9
Gastropoda	Planorbidae	-	2	0	0	0	0	0	0	0	0
Gastropoda	Valvatidae	-	0	1	1	0	0	0	0	0	0
Bivalvia	Dreissenidae	-	0	1	0	0	0	0	0	0	0
Bivalvia	Pisidiidae	-	0	0	0	1	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	7	0	0	0	0	0	4	0	0
Oligocaeta	Enchytraeidae	-	0	0	0	0	0	0	0	1	0
Oligocaeta	Haplotaxidae	-	2	13	0	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	59	49	10	4	2	12	3	13	18
Oligocaeta	Lumbriculidae	-	10	3	0	0	0	1	0	2	0
Oligocaeta	Naididae	-	0	3	0	3	47	0	1	0	0
Other taxa	Hydracarina	-	0	0	0	0	0	0	0	1	0
Other taxa	Mermithidae	-	2	2	1	4	13	1	0	4	0
		TOT	1129	2934	2551	718	4336	1308	1171	4960	886

Table 48 Absolute abundances (n° individuals / 0.5m^2) of macroinvertebrate *taxa* found in Adda river, site ADS5, from 2010 to 2012.

Taxon	Family	Genus	2010-01-07	2010-05-27	2010-09-03	2011-01-14	2011-04-07	2011-08-24	2011-12-14	2012-03-13	2012-06-22
Plecoptera	Leuctridae	*Leuctra*	2	0	12	0	7	3	0	3	2
Ephemeroptera	Baetidae	*Baetis*	205	94	543	232	536	128	459	243	119
Ephemeroptera	Caenidae	*Caenis*	7	48	91	5	10	18	64	27	0
Ephemeroptera	Heptageniidae	*Ecdyonurus*	46	22	27	44	103	9	95	44	10
Ephemeroptera	Ephemeridae	*Ephemera*	0	42	0	0	0	0	0	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	4	220	16	16	1209	14	22	775	25
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	14	6	14	1	0	0	0
Ephemeroptera	Oligoneuriidae	*Oligoneuriella*	0	0	0	0	21	0	0	0	1
Ephemeroptera	Potamanthidae	*Potamanthus*	0	2	0	0	0	0	0	0	0
Trichoptera	Glossosomatidae	-	0	0	1	0	0	10	0	0	0
Trichoptera	Goeridae	-	3	0	0	0	0	0	0	0	0
Trichoptera	Hydropsychidae	-	116	15	479	117	31	110	314	46	40
Trichoptera	Hydroptilidae	-	0	0	2	6	3	1	0	31	0
Trichoptera	Lepidostomatidae	-	3	0	0	1	0	0	0	0	0
Trichoptera	Leptoceridae	-	0	1	0	0	0	0	0	0	0
Trichoptera	Limnephilidae	-	0	0	1	0	0	0	0	0	0
Trichoptera	Polycentropodidae	-	0	0	1	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	2	0	4	2	13	10	87	31	0
Trichoptera	Rhyacophilidae	-	10	3	8	43	66	11	53	39	29
Coleoptera	Dryopidae	-	0	0	0	0	0	0	1	0	0
Coleoptera	Elminthidae	-	4	10	30.5	3	12	12	12	52	8
Coleoptera	Gyrinidae	-	2	0	0	0	1	0	4	1	0
Coleoptera	Hydrophilidae	-	0	1	0	0	0	0	0	0	0
Diptera	Chironomidae	-	36	25	197	494	421	0	240	928	19
Diptera	Empididae	-	0	2	0	0	3	0	0	1	0
Diptera	Limoniidae	-	5	0	1	0	3	0	0	8	0
Diptera	Psychodidae	-	0	0	0	1	0	0	0	0	0
Diptera	Simuliidae	-	172	3	69	144	72	0	213	25	96
Diptera	Tabanidae	-	1	0	1	0	0	0	0	1	0
Diptera	Tipulidae	-	1	0	0	0	0	0	0	0	0
Odonata	Calopterygidae	*Calopteryx*	0	1	0	0	0	0	0	0	0
Odonata	Gomphidae	*Onychogomphus*	0	0	0	0	1	0	0	0	0
Crustacea	Asellidae	-	0	0	1	1	0	0	0	0	0
Crustacea	Gammaridae	-	10	8	10	57	27	67	30	30	10
Gastropoda	Bythiniidae	-	0	0	2	0	0	0	0	0	1
Gastropoda	Neritidae	-	1	0	0	3	1	2	2	0	0
Gastropoda	Planorbidae	-	0	0	0	0	0	0	0	0	1
Bivalvia	Dreissenidae	-	1	0	0	0	0	0	1	0	0
Irudinea	Erpobdellidae	*Dina*	0	0	0	1	0	0	0	0	0
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	0	0	1	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	0	0	1	0	0	0	1	0	0
Oligocaeta	Enchytraeidae	-	0	0	1	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	13	2	26	4	3	5	0	0	4
Oligocaeta	Lumbriculidae	-	1	0	11	0	9	0	0	0	5
Oligocaeta	Naididae	-	0	0	0	0	6	0	2	0	0
Oligocaeta	Propappidae	-	0	0	5	0	0	0	0	0	0
Other taxa	Hydracarina	-	0	0	3	0	0	0	0	0	0
Other taxa	Mermithidae	-	0	0	0	3	0	0	0	0	0
		TOT	645	499	1557.5	1183	2572	402	1600	2285	370

Table 49 Absolute abundances (n° individuals / $0.5m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS6, from 2010 to 2012.

Taxon	Family	Genus	2009-12-17	2010-05-27	2010-09-02	2011-01-14	2011-04-07	2011-08-25	2011-12-14	2012-03-13	2012-06-25
Plecoptera	Leuctridae	*Leuctra*	1	1	1	1	2	1	0	0	8
Plecoptera	Nemouridae	*Nemoura*	0	0	0	2	0	0	0	0	0
Ephemeroptera	Baetidae	*Baetis*	143	29	111	56	294	527	377	2	182
Ephemeroptera	Caenidae	*Caenis*	57	3	6	7	10	53	39	2	5
Ephemeroptera	Heptageniidae	*Ecdyonurus*	15	6	9	14	22	15	109	94	4
Ephemeroptera	Heptageniidae	*Electrogena*	1	0	0	0	0	0	0	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	0	7	1	2	295	20	16	851	15
Ephemeroptera	Heptageniidae	*Heptagenia*	5	0	4	1	1	2	11	0	0
Ephemeroptera	Oligoneuriidae	*Oligoneuriella*	0	1	0	0	4	0	0	0	1
Ephemeroptera	Potamanthidae	*Potamanthus*	2	0	0	0	8	0	6	0	9
Trichoptera	Hydropsychidae	-	69	0	279	13	12	157	91	15	30
Trichoptera	Hydroptilidae	-	0	0	9	0	3	17	0	0	0
Trichoptera	Limnephilidae	-	1	0	0	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	17	0	1	0	15	12	17	6	0
Trichoptera	Rhyacophilidae	-	9	3	3	9	9	8	7	0	4
Coleoptera	Dryopidae	-	0	0	1	2	1	0	0	0	0
Coleoptera	Elminthidae	-	6	0	7	2	9	27	3	16	4
Diptera	Ceratopogonidae	-	3	0	2	0	5	1	1	0	1
Diptera	Chironomidae	-	12	1	136	373	666	1548	1228	317	66
Diptera	Empididae	-	0	0	1	0	5	5	0	2	0
Diptera	Limoniidae	-	5	0	0	0	2	1	0	1	0
Diptera	Psychodidae	-	1	0	0	0	0	0	0	0	0
Diptera	Simuliidae	-	24	5	66	39	20	5	191	12	37
Diptera	Tabanidae	-	0	0	6	0	0	0	0	0	0
Diptera	Tipulidae	-	1	0	0	0	0	0	0	0	0
Odonata	Gomphidae	*Onychogomphus*	0	0	0	0	0	2	0	0	0
Eteroptera	Aphelocheiridae	-	0	0	0	0	0	2	0	0	0
Eteroptera	Naucoridae	-	0	1	0	0	0	0	0	0	0
Crustacea	Asellidae	-	0	0	0	0	0	0	0	0	1
Crustacea	Gammaridae	-	18	1	1	16	5	12	16	15	54
Gastropoda	Lymnaeidae	-	0	0	0	0	1	0	0	0	0
Gastropoda	Neritidae	-	0	0	0	0	0	1	0	0	0
Bivalvia	Dreissenidae	-	0	0	0	0	0	0	1	0	0
Irudinea	Erpobdellidae	*Dina*	2	0	0	0	0	0	0	0	1
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	0	0	7	2	0	0
Turbellaria	Dugesiidae	*Dugesia*	0	0	0	0	0	0	3	0	0
Turbellaria	Planariidae	*Polycelis*	0	0	0	0	1	0	0	0	0
Oligocaeta	Haplotaxidae	-	2	0	0	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	9	0	1	4	2	1	6	0	0
Oligocaeta	Lumbriculidae	-	1	0	12	0	3	1	0	0	0
Oligocaeta	Naididae	-	0	0	0	297	304	0	76	0	0
Oligocaeta	Tubificidae	-	0	0	0	7	0	0	0	0	0
Other taxa	Mermithidae	-	6	0	0	6	13	0	9	0	0
		TOT	410	58	657	851	1712	2425	2209	1333	422

Table 50 Absolute abundances (n° individuals / 0.5m^2) of macroinvertebrate *taxa* found in Adda river, site ADS7, from 2010 to 2012.

Taxon	Family	Genus	2009-12-17	2009-12-17	2009-12-17	2009-12-17	2009-12-17	2009-12-17	2009-12-17	2009-12-17
Plecoptera	Leuctridae	*Leuctra*	0	0	0	0	2	0	0	5
Ephemeroptera	Baetidae	*Baetis*	21	124	13	119	679	28	54	185
Ephemeroptera	Caenidae	*Caenis*	1	7	1	16	88	8	12	3
Ephemeroptera	Heptageniidae	*Ecdyonurus*	5	4	1	10	6	4	38	1
Ephemeroptera	Ephemerellidae	*Ephemerella*	20	2	4	232	5	1	822	32
Ephemeroptera	Heptageniidae	*Heptagenia*	0	3	0	2	2	0	0	0
Ephemeroptera	Oligoneuriidae	*Oligoneuriella*	1	0	0	1	0	0	0	1
Ephemeroptera	Potamanthidae	*Potamanthus*	2	0	0	2	0	0	0	6
Trichoptera	Glossosomatidae	-	0	2	0	0	2	0	0	0
Trichoptera	Goeridae	-	0	0	0	1	0	0	0	0
Trichoptera	Hydropsychidae	-	1	36	4	18	67	38	2	23
Trichoptera	Hydroptilidae	-	0	2	0	2	1	3	0	0
Trichoptera	Lepidostomatidae	-	0	0	1	1	0	0	0	0
Trichoptera	Leptoceridae	-	0	0	2	1	0	0	0	0
Trichoptera	Limnephilidae	-	0	0	0	0	0	0	1	0
Trichoptera	Psychomyidae	-	0	1	7	6	21	27	0	0
Trichoptera	Rhyacophilidae	-	3	1	3	4	0	0	0	0
Coleoptera	Dryopidae	-	0	0	2	0	0	0	0	0
Coleoptera	Elminthidae	-	3	1	0	2	20	4	18	2
Coleoptera	Gyrinidae	-	0	0	0	1	0	0	0	0
Diptera	Ceratopogonidae	-	0	0	0	11	1	0	0	2
Diptera	Chironomidae	-	6	265	59	235	676	176	613	149
Diptera	Empididae	-	0	0	0	7	0	0	20	0
Diptera	Limoniidae	-	2	0	2	1	1	0	2	0
Diptera	Simuliidae	-	15	0	3	2	0	11	3	2
Diptera	Tabanidae	-	0	0	1	0	1	2	0	0
Diptera	Tipulidae	-	0	0	0	0	0	1	0	0
Odonata	Gomphidae	*Onychogomphus*	0	1	0	0	0	0	0	3
Eteroptera	Aphelocheiridae	-	3	1	0	2	1	3	0	0
Eteroptera	Naucoridae	-	0	0	0	0	0	0	1	0
Crustacea	Asellidae	-	0	0	0	1	0	0	0	0
Crustacea	Gammaridae	-	15	43	57	53	32	7	43	284
Gastropoda	Bythiniidae	-	0	0	1	1	2	0	2	0
Gastropoda	Lymnaeidae	-	0	0	2	0	0	0	0	1
Gastropoda	Neritidae	-	0	1	4	0	0	1	0	0
Gastropoda	Physidae	-	0	0	0	2	0	0	0	0
Gastropoda	Planorbidae	-	0	0	0	1	0	0	0	0
Bivalvia	Pisidiidae	-	0	0	0	0	0	0	0	1
Bivalvia	Corbiculidae	-	0	0	0	1	3	1	0	0
Irudinea	Erpobdellidae	*Dina*	0	0	0	0	0	1	0	1
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	0	0	1	0	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	0	0	0	0	1	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	0	0	0	0	1	0	0	0
Oligocaeta	Lumbricidae	-	2	0	12	4	0	29	2	11
Oligocaeta	Lumbriculidae	-	0	1	0	1	5	0	0	0
Oligocaeta	Naididae	-	0	0	0	67	0	0	0	2
Oligocaeta	Tubificidae	-	0	0	2	0	0	0	0	0
Other taxa	Mermithidae	-	0	1	0	23	0	0	0	0
		TOT	100	496	181	830	1617	346	1633	714

Table 51 Fish species found in Ticino during 2010 and 2011. For each species relative abundances (A) are indicated, on a scale between 1 and 4 and population structure (S) with A = presence of individuals of all age classes, B = prevalence of juveniles, or C = prevalence of adults; ND = population strucure not determinable because of a too scarce abundance. Names in bold are alien species for Ticino; names with star symbol are species of community importance (Dir. 92/43/CEE).

	TIC1		**TIC2**		**TIC3**		**TIC4**	
Species	**A**	**S**	**A**	**S**	**A**	**S**	**A**	**S**
Alburnus alburnus alborella	1	ND	1	ND	2	A	3	A
Anguilla anguilla	2	C			1	ND	1	ND
Barbus barbus							1	ND
Barbus plebejus *	3	A	3	B	2	A	3	A
Carassius carassius	1	ND	1	ND	1	ND	2	B
Chondrostoma soetta							1	ND
Cobitis taenia bilineata *	3	A	3	A	2	A	3	A
Cottus gobio *							1	ND
Cyprinus carpio	2	A	1	ND	1	ND	1	ND
Esox lucius					2	A		
Gobio gobio							1	ND
Knipowitschia punctatissima							2	A
Lepomis gibbosus	2	A			1	ND	1	ND
Leuciscus cephalus	3	B	2	A	3	A	2	A
Leuciscus souffia muticellus *	3	A	3	A	3	A	3	A
Lota lota							1	ND
Misgurnus anguillicaudatus					1	ND		
*Padogobius martensii**	4	A	4	A	3	A	3	A
Perca fluviatilis	2	B			1	ND	2	B
Phoxinus phoxinus	4	A	3	A	3	A	3	A
Pseudorasbora parva					1	ND	1	ND
Rhodeus sericeus amarus	3	A	1	ND	2	A	2	A
Rutilus erythrophthalmus	2	A	1	ND	3	A	3	A
Rutilus pigus *	1	ND					1	ND
Rutilus rutilus	3	B			3	A	2	B
*Sabanejewia larvata**					1	ND		
Salaria fluviatilis	4	A	4	A	3	A	3	A
Scardinius erythrophthalmus	1	ND	1	ND	2	A	2	B
Silurus glanis					1	ND	2	C
Tinca tinca	3	B	1	ND	2	A	3	B

Table 52 Fish species found in Adda during 2010 and 2011. For each species relative abundances (A) are indicated, on a scale between 1 and 4 and population structure (S) with A = presence of individuals of all age classes, B = prevalence of juveniles, or C = prevalence of adults; ND = population strucure not determinable because of a too scarce abundance. Names in bold are alien species for Adda; names with star symbol are species of community importance (Dir. 92/43/CEE).

	ADS1		ADS2		ADS3		ADS4		ADS5		ADS6	
Species	**A**	**S**	**A**	**S**	**A**	**S**	**A**	**S**	**A**	**S**	**A**	**S**
Abramis brama									1	ND	1	ND
Acipenser naccarii *			1	ND								
Alburnus alburnus alborella	1	ND					1	ND	1	A	3	A
Anguilla anguilla	2	C	1	ND	1	ND			2	C	1	C
Barbus barbus	2	A	1	A	3	A	3	B	3	B	3	B
Barbus plebejus *	2	A	3	A	3	A	3	B	3	B	3	B
Carassius carassius			2	A					2	B	1	ND
Chondrostoma genei *							3	C				
Chondrostom soetta									1	ND		
Cobitis taenia bilineata *	2	C	3	A			4	A	3	A	2	A
Cottus gobio *	3	A	3	A	3	A	3	A	3	A	1	ND
Cyprinus carpio			2	A					2	A		
Esox lucius	1	ND	1	ND					1	ND	1	ND
Gobio gobio	2	A	2	A					2	A	2	A
Lepomis gibbosus			1	ND					1	A		
Leuciscus cephalus	3	B	3	A	3	A	2	B	3	A	4	A
Leuciscus souffia muticellus *	3	A	3	A	3	A	4	A	4	A	3	A
Misgurnus anguillicaudatus									2	A		
*Padogobius martensii**	3	A	3	A	1	A	4	A	4	A	3	A
Perca fluviatilis	3	B	3	A	2	B	1	ND	3	A	3	B
Phoxinus phoxinus			2	A	3	A	4	A	2	A	3	A
Pseudorasbora parva									2	A	2	A
Rhodeus sericeus amarus	3	A	3	A			1	C	2	A	1	A
Rutilus erythrophthalmus	3	A	2	A	1	ND	1	ND	1	ND	2	A
Rutilus pigus *	1	ND			1	ND						
Salaria fluviatilis	4	A	3	A	2	A	1	ND	2	A	3	A
Salmo trutta fario	1	ND			1	ND						
Salmo trutta fario* X *marmoratus			1	ND	1	ND						
Salmo trutta marmoratus *			1	ND	2	A	2	A	2	A	1	ND
Scardinius erythrophthalmus			2	B	3	B	1	ND	3	B	2	B
Silurus glanis			1	ND					1	ND	2	A
Stizostedion lucioperca			1	ND								
Tinca tinca	2	B	1	B							1	ND
Thymallus thymallus					1	ND	1	ND	1	ND	1	ND

Structural approach

Table 53 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS2, on 2011/01/17 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	Family	Genus	MES1	MES2	MES3	MES4	MES5	MES6	MES7	MES8	MAC1	MAC2
Plecoptera	Leuctridae	*Leuctra*	2	0	0	0	0	0	0	0	0	0
Ephemeroptera	Baetidae	*Baetis*	153	96	21	66	68	97	28	53	12	34
Ephemeroptera	Caenidae	*Caenis*	20	11	0	8	1	11	4	2	1	1
Ephemeroptera	Heptageniidae	*Ecdyonurus*	9	2	0	1	0	3	3	2	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	11	4	2	4	7	9	3	11	2	0
Ephemeroptera	Heptageniidae	*Heptagenia*	3	0	0	0	2	2	0	0	0	0
Ephemeroptera	Potamanthidae	*Potamanthus*	0	0	0	1	0	0	0	0	0	0
Trichoptera	Goeridae	-	1	1	0	0	0	4	0	0	0	0
Trichoptera	Hydropsychidae	-	343	147	105	177	202	308	67	255	7	3
Trichoptera	Hydroptilidae	-	30	2	0	0	6	2	0	0	0	1
Trichoptera	Lepidostomatidae	-	15	0	0	0	1	4	0	0	0	0
Trichoptera	Leptoceridae	-	6	1	0	0	0	4	0	0	0	0
Trichoptera	Philopotamidae	-	1	0	0	0	0	0	0	0	0	0
Trichoptera	Polycentropodidae	-	0	0	0	0	0	0	0	0	0	1
Trichoptera	Psychomyidae	-	10	40	62	28	13	46	0	68	6	14
Trichoptera	Rhyacophilidae	-	12	15	13	9	0	6	3	9	15	1
Trichoptera	Sericostomatidae	-	1	0	0	0	0	0	0	0	0	0
Coleoptera	Elminthidae	-	26	105	52	21	11	107	11	108	4	0
Coleoptera	Gyrinidae	-	0	1	0	0	0	0	0	0	0	0
Diptera	Chironomidae	-	49	40	25	30	28	57	13	63	41	35
Diptera	Empididae	-	0	0	0	0	0	0	0	0	1	0
Diptera	Limoniidae	-	5	9	7	1	3	5	0	4	23	1
Diptera	Simuliidae	-	20	2	1	1	6	9	0	9	3	0
Eteroptera	Aphelocheiridae	-	3	0	1	0	0	1	0	0	0	0
Crustacea	Asellidae	-	3	1	0	0	0	0	0	0	0	0
Crustacea	Gammaridae	-	30	4	2	3	0	3	0	0	3	0
Gastropoda	Ancylidae	-	20	31	23	37	15	25	9	39	2	7
Gastropoda	Bythiniidae	-	0	0	0	0	0	4	0	0	0	0
Gastropoda	Lymnaeidae	-	2	0	0	0	0	0	0	0	0	0
Gastropoda	Neritidae	-	10	8	4	3	0	9	3	8	0	0
Bivalvia	Dreissenidae	-	8	1	1	0	1	0	0	0	0	0
Bivalvia	Corbiculidae	-	0	1	0	0	0	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	16	14	5	3	5	26	6	7	1	0
Oligocaeta	Lumbricidae	-	19	7	12	2	0	26	2	11	0	2
Oligocaeta	Lumbriculidae	-	2	0	0	0	0	0	1	0	0	0
Oligocaeta	Naididae	-	4	5	0	0	1	2	0	1	9	1
Oligocaeta	Propappidae	-	0	0	0	1	0	0	0	0	0	0
Oligocaeta	Tubificidae	-	0	0	0	1	0	0	0	0	0	0
Other taxa	Hydracarina	-	0	2	0	2	0	14	0	2	0	0
Other taxa	Mermithidae	-	2	1	1	1	0	0	0	1	0	0

Table 54 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS2, on 2011/04/08 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	Family	Genus	MES1	MES2	MES3	MES4	MES5	MES6	MES7	MES8	MAC1	MAC2	MAC3	MAC4	MAC5
Ephemeroptera	Baetidae	*Baetis*	7	79	35	53	17	35	0	42	36	19	54	28	43
Ephemeroptera	Caenidae	*Caenis*	6	24	15	14	12	14	8	1	7	3	9	8	13
Ephemeroptera	Heptageniidae	*Ecdyonurus*	5	13	8	3	1	5	0	0	3	2	1	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	11	159	118	270	164	266	0	97	43	80	144	26	71
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	1	2	0	1	0	0	0	1	3	0	1
Trichoptera	Goeridae	-	0	0	0	0	1	2	0	0	0	0	0	0	0
Trichoptera	Hydropsychidae	-	11	66	81	235	202	314	98	76	17	98	341	121	217
Trichoptera	Hydroptilidae	-	15	90	10	2	0	0	0	3	13	0	0	51	2
Trichoptera	Lepidostomatidae	-	0	1	0	0	0	5	0	0	0	0	0	3	1
Trichoptera	Leptoceridae	-	1	0	1	0	0	1	0	3	0	0	1	1	0
Trichoptera	Limnephilidae	-	0	0	0	1	0	0	0	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	3	60	69	108	90	165	0	70	20	20	112	18	45
Trichoptera	Rhyacophilidae	-	1	8	3	4	6	3	0	0	1	2	0	0	1
Coleoptera	Elminthidae	-	7	23	34	47	42	208	59	42	9	9	32	46	61
Coleoptera	Gyrinidae	-	0	1	0	0	0	0	0	0	0	0	0	3	2
Diptera	Chironomidae	-	62	478	243	695	434	709	237	781	232	386	1176	464	860
Diptera	Empididae	-	4	4	1	0	1	0	0	1	0	0	0	19	0
Diptera	Limoniidae	-	27	41	11	10	17	13	7	10	8	1	16	213	31
Diptera	Simuliidae	-	0	1	0	1	1	1	0	1	1	0	1	0	2
Eteroptera	Aphelocheiridae	-	0	0	0	0	0	4	0	0	0	0	0	2	0
Crustacea	Asellidae	-	0	0	0	0	0	0	0	0	1	0	0	1	0
Crustacea	Gammaridae	-	2	6	3	0	2	1	0	0	9	0	1	4	2
Gastropoda	Ancylidae	-	0	23	11	34	23	37	0	8	0	6	12	0	1
Gastropoda	Bythiniidae	-	0	0	0	0	0	3	0	0	0	0	28	0	0
Gastropoda	Lymnaeidae	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Gastropoda	Neritidae	-	0	13	21	35	19	11	0	5	0	13	6	0	0
Bivalvia	Dreissenidae	-	0	1	0	2	1	2	0	1	0	0	5	1	0
Bivalvia	Corbiculidae	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	0	4	6	5	6	15	0	2	0	4	13	4	8
Oligocaeta	Haplotaxidae	-	0	0	0	0	0	2	0	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	0	3	2	1	4	5	0	0	2	0	0	0	2
Oligocaeta	Lumbriculidae	-	0	0	0	0	0	6	0	0	2	0	0	3	26
Oligocaeta	Naididae	-	36	18	48	101	8	53	0	187	38	38	56	187	107
Oligocaeta	Propappidae	-	0	0	2	0	0	0	0	0	0	0	0	0	0
Other taxa	Hydracarina	-	0	7	6	4	1	2	0	1	0	0	1	1	1
Other taxa	Mermithidae	-	0	0	3	1	0	0	0	0	0	0	0	0	0

Table 55 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS2, on 2011/08/23 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**	**MES8**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**
Plecoptera	Leuctridae	*Leuctra*	13	12	0	5	4	2	0	4	7	14	0	1	3
Ephemeroptera	Baetidae	*Baetis*	36	70	75	47	83	67	81	38	94	7	33	85	77
Ephemeroptera	Caenidae	*Caenis*	9	10	0	16	9	25	4	12	11	21	7	8	22
Ephemeroptera	Heptageniidae	*Ecdyonurus*	2	2	15	4	2	1	0	4	1	2	0	0	2
Ephemeroptera	Ephemerellidae	*Ephemerella*	6	8	7	10	0	8	3	2	9	5	1	1	8
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	3	0	0	0	0	3	2	0	1	0	0
Trichoptera	Goeridae	-	6	5	0	0	0	0	1	0	6	0	0	1	0
Trichoptera	Hydropsychidae	-	130	89	140	359	291	143	171	53	158	251	163	163	205
Trichoptera	Hydroptilidae	-	23	7	0	0	0	0	0	7	5	5	0	1	2
Trichoptera	Lepidostomatidae	-	0	0	1	0	0	0	0	5	5	1	0	1	0
Trichoptera	Leptoceridae	-	1	0	0	0	0	0	0	0	1	0	0	0	0
Trichoptera	Limnephilidae	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	34	44	2	8	12	10	10	9	9	36	6	3	11
Trichoptera	Rhyacophilidae	-	16	16	0	6	3	4	1	0	7	3	0	1	3
Coleoptera	Elminthidae	-	34	34	11	16	12	16	13	42	63	20	7	4	9
Coleoptera	Gyrinidae	-	0	0	0	0	0	0	0	0	1	0	0	0	0
Diptera	Athericidae	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Diptera	Chironomidae	-	15	9	7	5	3	1	2	11	31	22	11	1	5
Diptera	Empididae	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Limoniidae	-	41	39	1	2	0	0	0	1	25	11	0	1	1
Diptera	Simuliidae	-	8	10	10	15	12	1	5	3	143	309	2	0	12
Odonata	Calopterygidae	*Calopteryx*	0	1	0	0	0	0	0	0	1	0	0	0	0
Odonata	Gomphidae	*Onychogomphus*	0	1	0	0	0	0	0	0	0	0	0	0	0
Eteroptera	Aphelocheiridae	-	3	2	1	2	0	1	0	2	8	0	0	0	0
Crustacea	Asellidae	-	0	1	0	0	0	0	0	0	2	0	0	0	0
Crustacea	Gammaridae	-	22	7	0	0	0	0	0	0	28	2	0	0	0
Gastropoda	Ancylidae	-	4	1	13	3	2	2	2	18	0	1	5	1	2
Gastropoda	Bythiniidae	-	7	3	0	0	3	6	0	35	213	2	0	0	0
Gastropoda	Lymnaeidae	-	0	0	0	0	0	0	0	0	21	1	0	0	0
Gastropoda	Neritidae	-	34	40	37	47	45	61	16	54	35	10	15	6	0
Gastropoda	Physidae	-	0	0	0	0	0	0	0	0	2	0	0	0	0
Gastropoda	Planorbidae	-	1	0	0	1	0	0	0	1	0	0	0	0	0
Gastropoda	Valvatidae	-	0	0	0	0	0	0	0	1	2	0	0	0	0
Bivalvia	Dreissenidae	-	3	3	2	2	1	8	0	1	11	0	0	0	1
Bivalvia	Pisidiidae	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Bivalvia	Corbiculidae	-	0	2	0	0	0	0	0	4	7	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	7	19	12	12	17	7	0	8	22	14	4	8	2
Oligocaeta	Lumbricidae	-	22	21	2	9	10	8	16	12	20	7	4	1	6
Oligocaeta	Lumbriculidae	-	0	2	0	5	2	50	4	4	0	0	0	5	0
Other taxa	Hydracarina	-	0	2	0	0	0	0	0	2	0	1	0	0	0
Other taxa	Mermithidae	-	0	0	1	0	0	0	0	0	1	1	0	0	2

Table 56 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS2, on 2011/12/13 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	Family	Genus	MES1	MES2	MES3	MES4	MES5	MES6	MES7	MES8	MAC1	MAC2	MAC3	MAC4	MAC5
Ephemeroptera	Baetidae	*Baetis*	14	39	7	14	12	21	34	3	0	1	37	5	38
Ephemeroptera	Caenidae	*Caenis*	7	8	1	8	11	0	0	0	3	0	0	2	0
Ephemeroptera	Heptageniidae	*Ecdyonurus*	1	1	1	0	0	0	1	3	3	0	0	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	0	0	0	1	0	0	2	0	0	0	0	0	0
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	1	0	0	0	0	0	0	0	0	0	0
Trichoptera	Hydropsychidae	-	27	96	57	125	106	181	105	10	13	17	496	150	27
Trichoptera	Hydroptilidae	-	20	0	0	0	0	0	0	48	32	1	0	1	12
Trichoptera	Lepidostomatidae	-	2	1	4	1	0	1	0	2	9	1	0	0	3
Trichoptera	Leptoceridae	-	4	0	0	0	0	1	0	3	4	1	0	0	28
Trichoptera	Polycentropodidae	-	1	0	0	0	0	0	0	0	0	0	0	7	0
Trichoptera	Psychomyidae	-	3	13	12	49	68	49	18	9	8	0	38	21	1
Trichoptera	Rhyacophilidae	-	0	13	3	1	2	1	5	2	1	1	10	0	0
Coleoptera	Dryopidae	-	0	0	0	0	0	0	0	0	0	0	1	0	0
Coleoptera	Elminthidae	-	44	90	12	33	49	45	50	29	52	7	42	14	32
Coleoptera	Gyrinidae	-	1	3	0	0	0	0	0	3	0	0	0	0	0
Diptera	Athericidae	-	0	0	1	0	0	0	0	0	0	0	0	0	0
Diptera	Chironomidae	-	15	111	29	24	69	56	109	19	13	25	126	22	39
Diptera	Empididae	-	0	0	0	0	0	0	0	0	2	0	0	0	0
Diptera	Limoniidae	-	12	45	4	0	3	1	32	12	25	0	2	1	7
Diptera	Simuliidae	-	0	32	106	68	6	113	10	0	0	0	299	9	56
Odonata	Calopterygidae	*Calopteryx*	0	0	0	0	0	0	0	0	0	0	0	0	2
Odonata	Gomphidae	*Onychogomphus*	1	0	0	0	0	0	0	0	1	0	0	0	0
Eteroptera	Aphelocheiridae	-	1	4	0	0	0	0	0	0	2	0	0	0	2
Crustacea	Asellidae	-	1	0	0	0	0	0	0	0	0	0	0	0	2
Crustacea	Gammaridae	-	7	2	0	0	0	0	0	0	0	0	0	0	12
Gastropoda	Ancylidae	-	0	0	0	2	1	1	4	0	0	0	0	1	0
Gastropoda	Bythiniidae	-	5	2	2	0	0	0	0	0	0	0	1	0	42
Gastropoda	Hydrobioidaea	-	1	0	0	0	0	0	0	0	0	0	0	0	2
Gastropoda	Lymnaeidae	-	2	1	0	0	0	0	0	0	0	0	0	1	2
Gastropoda	Neritidae	-	6	27	11	24	38	12	11	0	0	1	13	0	8
Gastropoda	Physidae	-	0	0	0	0	0	0	0	0	0	0	0	0	1
Gastropoda	Planorbidae	-	0	0	0	0	0	0	0	0	0	0	0	7	1
Bivalvia	Dreissenidae	-	2	7	0	4	1	0	1	1	3	0	1	6	3
Bivalvia	Pisidiidae	-	3	0	0	0	0	0	0	0	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	16	43	14	11	11	9	8	4	15	5	21	16	33
Oligocaeta	Enchytraeidae	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	3	10	0	3	8	1	6	4	0	1	11	8	7
Oligocaeta	Lumbriculidae	-	0	0	0	0	0	0	1	0	0	2	0	0	0
Oligocaeta	Naididae	-	0	0	0	0	0	0	0	0	1	0	0	0	4
Other taxa	Mermithidae	-	0	0	0	0	0	0	0	0	0	0	1	1	0

Table 57 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS3, on 2011/04/08 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MAC6**
Plecoptera	Leuctridae	*Leuctra*	4	3	8	0	1	7	0	0	0	1	0
Ephemeroptera	Baetidae	*Baetis*	22	53	125	41	57	44	31	61	34	99	44
Ephemeroptera	Caenidae	*Caenis*	9	3	33	0	40	8	1	1	0	7	1
Ephemeroptera	Heptageniidae	*Ecdyonurus*	0	1	7	0	4	1	0	5	3	5	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	52	77	243	111	224	94	53	210	92	170	36
Trichoptera	Hydropsychidae	-	0	2	16	4	8	1	0	0	1	2	1
Trichoptera	Hydroptilidae	-	1	2	17	35	51	0	2	1	3	2	0
Trichoptera	Lepidostomatidae	-	0	0	1	0	0	0	0	0	0	0	0
Trichoptera	Leptoceridae	-	0	0	0	0	0	1	0	0	0	0	0
Trichoptera	Limnephilidae	-	0	0	1	1	0	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	75	30	107	12	103	50	33	42	1	16	6
Trichoptera	Rhyacophilidae	-	1	0	11	45	1	0	0	4	10	6	5
Coleoptera	Dryopidae	-	0	0	0	1	0	0	0	0	0	0	0
Coleoptera	Elminthidae	-	2	11	12	5	9	1	0	2	0	2	0
Coleoptera	Gyrinidae	-	0	0	0	0	1	0	0	0	0	0	0
Diptera	Chironomidae	-	1212	1328	1989	1205	1931	2112	1161	2932	1011	1648	812
Diptera	Empididae	-	1	9	0	2	0	2	0	0	0	1	0
Diptera	Limoniidae	-	24	3	69	156	145	37	17	12	7	8	5
Diptera	Simuliidae	-	0	0	7	17	0	0	0	1	7	30	2
Crustacea	Asellidae	-	0	2	0	0	1	0	0	0	0	0	0
Crustacea	Gammaridae	-	0	12	7	1	32	3	1	1	0	0	0
Gastropoda	Ancylidae	-	1	2	8	2	6	0	0	0	0	0	0
Gastropoda	Neritidae	-	0	0	1	0	0	0	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	0	0	0	0	3	0	0	0	0	0	0
Turbellaria	Planariidae	*Polycelis*	0	0	0	0	0	0	0	0	0	0	1
Oligocaeta	Enchytraeidae	-	0	0	0	0	0	2	0	0	0	0	4
Oligocaeta	Lumbricidae	-	0	7	2	0	1	0	0	0	0	1	2
Oligocaeta	Lumbriculidae	-	0	1	0	22	3	7	0	0	0	0	0
Oligocaeta	Naididae	-	802	349	670	79	562	617	306	957	104	640	158
Oligocaeta	Propappidae	-	0	0	0	0	0	2	0	0	0	0	0
Oligocaeta	Tubificidae	-	0	0	0	0	4	3	4	0	0	0	6
Other taxa	Mermithidae	-	13	18	1	2	5	13	2	4	0	0	0

Table 58 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS3, on 2011/08/23 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**
Plecoptera	Leuctridae	*Leuctra*	2	4	4	1	2	6	5	16	2	4	8
Ephemeroptera	Baetidae	*Baetis*	6	15	39	107	50	137	44	38	10	61	61
Ephemeroptera	Caenidae	*Caenis*	7	5	1	9	9	0	18	29	0	7	14
Ephemeroptera	Heptageniidae	*Ecdyonurus*	1	3	2	12	2	5	3	5	0	3	6
Ephemeroptera	Ephemerellidae	*Ephemerella*	18	16	8	9	44	62	17	13	6	17	18
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	0	0	0	0	0	1	0	0	0
Trichoptera	Goeridae	-	1	0	0	0	0	0	0	0	0	0	0
Trichoptera	Hydropsychidae	-	10	26	43	91	195	137	64	79	13	70	212
Trichoptera	Hydroptilidae	-	44	55	3	4	35	6	9	5	8	3	10
Trichoptera	Lepidostomatidae	-	2	1	0	0	0	0	1	0	1	0	0
Trichoptera	Leptoceridae	-	1	0	0	0	0	0	0	0	0	0	0
Trichoptera	Limnephilidae	-	0	0	0	2	0	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	15	59	31	37	30	24	9	9	17	32	40
Trichoptera	Rhyacophilidae	-	0	0	6	1	16	1	1	3	0	1	0
Coleoptera	Elminthidae	-	3	3	1	2	2	3	2	4	2	4	0
Diptera	Chironomidae	-	155	6	9	12	35	13	9	39	1	7	39
Diptera	Limoniidae	-	8	17	2	1	105	6	5	0	11	1	2
Diptera	Simuliidae	-	1	0	6	92	2	13	1	0	0	10	70
Crustacea	Asellidae	-	0	0	0	1	0	0	0	0	0	0	0
Crustacea	Gammaridae	-	4	2	2	0	0	5	4	6	0	1	0
Gastropoda	Ancylidae	-	0	61	3	0	0	0	18	17	26	2	0
Gastropoda	Bythiniidae	-	5	8	0	0	4	13	0	0	0	0	1
Gastropoda	Neritidae	-	1	0	9	0	41	1	10	16	10	0	0
Gastropoda	Planorbidae	-	0	1	0	0	0	0	0	0	0	0	0
Bivalvia	Dreissenidae	-	0	0	0	0	1	1	0	0	0	0	0
Irudinea	Erpobdellidae	*Erpobdella*	0	0	1	0	0	0	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	10	2	0	0	2	3	2	4	0	2	0
Oligocaeta	Lumbricidae	-	2	1	5	2	4	4	8	7	2	9	2
Oligocaeta	Lumbriculidae	-	1	0	0	0	0	0	0	1	0	1	0
Other taxa	Hydracarina	-	0	0	1	0	0	0	0	0	0	0	0
Other taxa	Mermithidae	-	0	0	0	0	0	0	0	0	0	1	0

Table 59 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS3, on 2011/12/13 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	Family	Genus	MES1	MES2	MES3	MES4	MES5	MAC1	MAC2	MAC3	MAC4	MAC5	MAC6
Plecoptera	Leuctridae	*Leuctra*	0	0	0	0	0	0	0	0	0	1	0
Ephemeroptera	Baetidae	*Baetis*	1	19	7	8	7	12	5	11	4	17	9
Ephemeroptera	Caenidae	*Caenis*	0	0	0	9	0	1	1	4	2	9	1
Ephemeroptera	Heptageniidae	*Ecdyonurus*	3	2	0	4	0	3	2	0	0	2	1
Ephemeroptera	Ephemerellidae	*Ephemerella*	3	1	1	13	1	5	4	2	2	14	2
Trichoptera	Hydropsychidae	-	2	5	5	6	6	10	7	2	5	7	2
Trichoptera	Hydroptilidae	-	0	0	0	0	0	0	1	0	0	0	0
Trichoptera	Lepidostomatidae	-	0	0	0	0	0	1	0	0	0	0	0
Trichoptera	Psychomyidae	-	0	1	0	20	0	11	52	8	3	38	16
Trichoptera	Rhyacophilidae	-	0	1	2	1	1	6	3	1	2	4	10
Coleoptera	Elminthidae	-	2	1	0	4	0	0	1	1	0	9	0
Coleoptera	Gyrinidae	-	0	0	1	0	0	0	0	0	0	0	0
Diptera	Chironomidae	-	41	59	76	186	21	92	143	34	54	152	103
Diptera	Limoniidae	-	1	0	0	4	0	0	2	0	0	2	9
Diptera	Simuliidae	-	0	29	82	11	8	49	1	11	9	5	1
Crustacea	Asellidae	-	0	1	0	0	0	0	0	0	1	0	0
Crustacea	Gammaridae	-	2	1	0	6	0	0	0	0	0	1	1
Gastropoda	Ancylidae	-	0	0	0	1	0	0	2	0	0	0	0
Gastropoda	Neritidae	-	0	0	0	1	0	0	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	1	0	1	0	0	0	0	0	0	0	0
Oligocaeta	Haplotaxidae	-	0	0	0	0	0	0	1	0	0	0	0
Oligocaeta	Lumbricidae	-	0	0	0	0	0	0	1	0	1	0	0
Oligocaeta	Lumbriculidae	-	0	0	0	0	0	0	0	1	0	2	0
Oligocaeta	Naididae	-	3	0	0	0	0	1	0	0	1	6	4
Other taxa	Mermithidae	-	0	0	0	3	0	0	1	1	0	1	0

Table 60 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS6, on 2011/04/07 for each subsample (MES = *mesolithal*, MIC = *microlithal*).

Taxon	Family	Genus	MIC1	MIC2	MIC3	MIC4	MIC5	MES1	MES2	MES3	MES4	MES5	MES6
Plecoptera	Leuctridae	*Leuctra*	0	0	0	0	1	1	0	0	0	0	1
Ephemeroptera	Baetidae	*Baetis*	41	19	10	35	68	65	10	13	37	43	21
Ephemeroptera	Caenidae	*Caenis*	1	1	0	0	6	1	0	1	1	3	2
Ephemeroptera	Heptageniidae	*Ecdyonurus*	4	2	0	2	4	1	0	1	0	9	3
Ephemeroptera	Ephemerellidae	*Ephemerella*	56	25	7	28	121	20	14	42	14	35	54
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	0	0	0	0	0	0	0	0	1
Ephemeroptera	Oligoneuriidae	*Oligoneuriella*	1	0	0	1	2	0	0	1	1	0	0
Ephemeroptera	Potamanthidae	*Potamanthus*	0	0	0	0	2	3	0	0	2	1	2
Trichoptera	Hydropsychidae	-	1	1	0	0	2	0	3	0	2	2	3
Trichoptera	Hydroptilidae	-	0	0	0	0	0	1	0	0	0	1	1
Trichoptera	Psychomyidae	-	0	1	0	0	0	6	1	1	1	3	2
Trichoptera	Rhyacophilidae	-	1	1	0	0	0	0	0	0	0	2	5
Coleoptera	Dryopidae	-	0	1	0	0	0	0	0	0	0	0	0
Coleoptera	Elminthidae	-	2	1	1	2	1	0	1	0	0	0	2
Diptera	Ceratopogonidae	-	0	2	0	0	0	1	1	1	0	0	0
Diptera	Chironomidae	-	40	59	2	40	116	126	23	89	78	190	19
Diptera	Empididae	-	1	0	0	2	4	0	0	0	0	0	2
Diptera	Limoniidae	-	0	0	1	0	0	0	0	0	0	0	1
Diptera	Simuliidae	-	0	1	1	1	2	1	1	0	2	4	9
Crustacea	Gammaridae	-	0	1	0	1	8	1	1	1	0	0	0
Gastropoda	Lymnaeidae	-	0	0	0	0	0	0	0	0	1	0	0
Turbellaria	Planariidae	*Polycelis*	0	0	0	0	0	0	0	0	0	1	0
Oligocaeta	Lumbricidae	-	2	0	0	0	1	0	0	0	0	0	0
Oligocaeta	Lumbriculidae	-	0	1	1	1	1	0	0	0	0	0	0
Oligocaeta	Naididae	-	32	3	0	56	3	80	6	37	36	41	13
Oligocaeta	Tubificidae	-	0	0	0	0	1	0	0	0	0	0	0
Other taxa	Mermithidae	-	1	2	3	1	0	4	0	0	0	0	2

Table 61 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS6, on 2011/08/28 for each subsample (MES = *mesolithal*, MIC = *microlithal*).

Taxon	Family	Genus	MIC1	MIC2	MIC3	MIC4	MIC5	MES1	MES2	MES3	MES4	MES5	MES6
Plecoptera	Leuctridae	*Leuctra*	0	0	0	1	0	0	0	0	0	0	0
Ephemeroptera	Baetidae	*Baetis*	0	49	17	44	24	0	118	77	83	104	35
Ephemeroptera	Caenidae	*Caenis*	4	7	2	1	12	0	13	5	4	3	14
Ephemeroptera	Heptageniidae	*Ecdyonurus*	0	2	0	0	0	0	10	1	0	2	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	2	4	0	0	2	0	9	4	1	0	0
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	1	0	0	0	0	1	0	0	0
Trichoptera	Hydropsychidae	-	8	10	9	7	7	2	36	38	26	13	8
Trichoptera	Hydroptilidae	-	0	0	0	0	0	0	11	0	2	1	3
Trichoptera	Psychomyidae	-	0	2	0	0	0	0	7	1	0	1	1
Trichoptera	Rhyacophilidae	-	1	1	0	0	0	0	3	2	1	0	0
Coleoptera	Elminthidae	-	2	3	2	3	0	0	10	3	1	1	2
Diptera	Ceratopogonidae	-	1	0	0	0	0	0	0	0	0	0	0
Diptera	Chironomidae	-	44	96	55	45	162	35	317	165	128	164	499
Diptera	Empididae	-	0	1	2	1	0	1	0	0	0	0	0
Diptera	Limoniidae	-	0	0	0	0	0	0	0	0	0	0	1
Diptera	Simuliidae	-	0	0	0	0	0	0	0	0	3	2	0
Odonata	Gomphidae	*Onychogomphus*	0	0	0	0	1	0	1	1	0	0	0
Eteroptera	Aphelocheiridae	-	1	0	0	0	0	1	0	0	0	0	0
Crustacea	Gammaridae	-	1	3	0	0	0	0	4	4	0	0	0
Gastropoda	Neritidae	-	0	0	0	0	0	0	0	1	0	0	0
Irudinea	Erpobdellidae	*Erpobdella*	1	0	1	0	0	0	3	0	0	0	2
Oligocaeta	Lumbricidae	-	0	0	0	0	0	0	1	0	0	0	0
Oligocaeta	Lumbriculidae	-	1	0	0	0	0	0	0	0	0	0	0

Table 62 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Adda river, site ADS6, on 2011/12/14 for each subsample (MES = *mesolithal*, MIC = *microlithal*).

Taxon	Family	Genus	MIC1	MIC2	MIC3	MIC4	MIC5	MES1	MES2	MES3	MES4	MES5	MES6
Ephemeroptera	Baetidae	*Baetis*	113	11	25	5	52	70	7	18	22	23	83
Ephemeroptera	Caenidae	*Caenis*	7	7	3	0	0	1	1	4	2	7	7
Ephemeroptera	Heptageniidae	*Ecdyonurus*	39	0	4	0	14	18	0	1	2	0	45
Ephemeroptera	Ephemerellidae	*Ephemerella*	8	3	4	0	3	0	1	0	0	0	0
Ephemeroptera	Heptageniidae	*Heptagenia*	0	2	0	0	6	3	0	0	0	1	5
Ephemeroptera	Potamanthidae	*Potamanthus*	0	2	0	0	0	0	0	1	1	0	2
Trichoptera	Hydropsychidae	-	5	3	6	3	9	12	16	3	12	13	18
Trichoptera	Lepidostomatidae	-	0	0	0	0	1	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	0	5	0	0	0	3	0	2	0	0	7
Trichoptera	Rhyacophilidae	-	1	1	0	0	0	1	2	0	1	0	1
Coleoptera	Elminthidae	-	0	0	1	1	0	0	0	0	0	1	0
Diptera	Ceratopogonidae	-	1	0	0	0	0	0	0	0	0	0	0
Diptera	Chironomidae	-	140	195	74	62	157	210	85	96	78	87	201
Diptera	Simuliidae	-	1	10	6	4	0	34	52	0	18	9	57
Crustacea	Gammaridae	-	10	1	1	0	4	2	0	0	0	0	2
Bivalvia	Dreissenidae	-	0	0	0	1	0	0	0	0	0	0	0
Irudinea	Erpobdellidae	*Erpobdella*	2	0	0	0	0	0	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	0	1	0	0	0	1	1	0	0	0	0
Oligocaeta	Lumbricidae	-	0	0	0	1	0	1	0	0	2	2	0
Oligocaeta	Naididae	-	8	17	31	0	6	0	1	5	2	0	12
Other taxa	Mermithidae	-	1	0	0	3	1	1	1	0	2	1	0

Table 63 Absolute abundances (n° individuals / 0.05m^2) of macroinvertebrate *taxa* found in Ticino river, site TIC1, on 2011/02/10 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**
Ephemeroptera	Baetidae	*Baetis*	32	78	135	122	190	2	84	54	43	2	3	59
Ephemeroptera	Caenidae	*Caenis*	21	6	11	27	86	14	22	3	14	37	57	29
Ephemeroptera	Heptageniidae	*Ecdyonurus*	2	5	4	12	2	24	20	17	23	0	2	7
Ephemeroptera	Ephemerellidae	*Ephemerella*	161	38	20	92	49	90	51	72	58	50	194	170
Trichoptera	Hydropsychidae	-	222	284	332	303	321	37	46	10	28	28	57	61
Trichoptera	Hydroptilidae	-	0	0	0	1	0	0	0	0	0	1	0	0
Trichoptera	Lepidostomatidae	-	0	0	0	0	2	0	1	0	0	0	2	1
Trichoptera	Leptoceridae	-	0	0	0	0	0	2	0	0	0	1	3	0
Trichoptera	Psychomyidae	-	2	3	2	5	8	5	0	1	2	6	7	21
Trichoptera	Rhyacophilidae	-	8	12	16	15	6	6	2	5	8	2	26	13
Coleoptera	Dryopidae	-	0	0	0	0	0	0	0	0	0	2	0	0
Coleoptera	Elminthidae	-	12	0	14	42	49	9	30	17	39	77	47	43
Diptera	Chironomidae	-	302	183	232	309	361	235	477	315	310	221	288	449
Diptera	Empididae	-	0	0	1	0	0	0	0	0	0	0	0	0
Diptera	Limoniidae	-	1	0	0	0	0	3	0	0	0	0	3	2
Diptera	Simuliidae	-	10	8	5	6	11	0	5	15	13	0	0	0
Odonata	Gomphidae	*Onychogomphus*	1	0	0	0	0	0	0	0	0	3	5	2
Odonata	Platycnemididae	*Platycnemis*	1	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Asellidae	-	0	0	0	1	2	2	0	0	0	2	3	3
Crustacea	Gammaridae	-	0	2	0	0	0	5	0	0	0	0	0	0
Gastropoda	Valvatidae	-	0	0	0	1	0	0	0	0	0	0	0	0
Bivalvia	Dreissenidae	-	0	1	0	0	0	0	0	0	0	0	0	0
Bivalvia	Sphaeriidae	-	0	0	0	1	1	0	0	0	0	0	0	0
Irudinea	Erpobdellidae	*Erpobdella*	1	0	1	0	0	1	2	1	0	0	1	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	2	0	0	1	3	0	0	0	0	1	0	0
Turbellaria	Dugesiidae	*Dugesia*	0	8	2	5	3	3	0	1	4	7	7	12
Turbellaria	Planariidae	*Polycelis*	0	0	0	0	0	0	0	0	0	2	0	0
Oligocaeta	Lumbricidae	-	0	0	1	1	1	0	7	0	0	0	2	4
Oligocaeta	Lumbriculidae	-	0	0	0	0	0	0	0	0	0	1	0	0
Oligocaeta	Naididae	-	9	2	0	16	7	80	1	7	0	167	74	17
Oligocaeta	Tubificidae	-	0	0	0	0	0	0	0	1	0	4	0	0
Other taxa	Hydracarina	-	0	0	0	0	0	0	0	1	0	2	0	0
Other taxa	Spongillidae	-	0	0	0	0	0	0	0	0	0	2	1	0
Other taxa	Mermithidae	-	1	0	0	0	2	0	1	0	1	5	3	2

Table 64 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC1, on 2011/03/04 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**
Ephemeroptera	Baetidae	*Baetis*	0	11	24	80	17	1	10	3	79	27	3	0
Ephemeroptera	Caenidae	*Caenis*	13	6	26	9	36	22	28	1	4	44	7	2
Ephemeroptera	Heptageniidae	*Ecdyonurus*	1	6	1	2	0	0	10	13	37	9	9	5
Ephemeroptera	Ephemerellidae	*Ephemerella*	22	137	92	61	78	110	182	102	98	255	135	152
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	0	1	0	0	0	0	0	0	0	0
Trichoptera	Hydropsychidae	-	18	9	373	61	392	17	28	53	27	133	21	9
Trichoptera	Hydroptilidae	-	0	0	0	1	0	1	0	0	0	0	1	0
Trichoptera	Lepidostomatidae	-	1	0	0	0	0	0	0	0	0	0	0	1
Trichoptera	Leptoceridae	-	0	0	0	0	1	1	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	0	2	6	14	4	5	5	4	7	3	5	3
Trichoptera	Rhyacophilidae	-	0	1	9	12	7	0	6	3	7	9	3	3
Coleoptera	Elminthidae	-	22	5	25	4	41	14	17	7	25	99	17	19
Diptera	Chironomidae	-	98	305	529	1019	319	728	200	214	1319	994	664	241
Diptera	Empididae	-	0	0	3	0	0	0	0	0	0	0	0	0
Diptera	Limoniidae	-	7	0	1	2	0	1	4	0	0	1	0	1
Diptera	Simuliidae	-	0	0	0	3	0	0	0	0	1	0	0	0
Odonata	Gomphidae	*Onychogomphus*	4	1	0	0	2	1	2	0	0	2	0	1
Crustacea	Asellidae	-	2	0	2	0	0	2	7	1	1	1	0	3
Crustacea	Gammaridae	-	0	0	0	1	9	0	0	0	0	0	0	1
Gastropoda	Planorbidae	-	0	0	0	0	0	1	0	0	0	0	0	0
Bivalvia	Dreissenidae	-	0	0	0	0	1	0	0	0	0	0	0	0
Bivalvia	Corbiculidae	-	0	0	0	0	0	0	0	0	0	1	0	0
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	0	1	0	2	2	0	0	0	2
Turbellaria	Dendrocoelidae	*Dendrocoelum*	0	0	6	0	1	1	2	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	9	0	4	3	4	3	1	1	1	24	2	1
Turbellaria	Planariidae	*Polycelis*	1	0	0	0	0	0	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	0	0	2	0	4	3	9	2	0	1	0	0
Oligocaeta	Lumbriculidae	-	0	0	0	0	0	0	0	0	0	1	0	0
Oligocaeta	Naididae	-	17	0	2	83	7	295	2	0	18	105	29	40
Oligocaeta	Propappidae	-	3	0	0	0	0	5	0	0	0	0	0	0
Other taxa	Hydracarina	-	0	0	0	0	0	0	0	0	0	1	0	1
Other taxa	Mermithidae	-	0	0	1	1	0	1	0	0	0	0	0	0

Table 65 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC1, on 2011/04/07 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**
Plecoptera	Leuctridae	*Leuctra*	1	0	0	0	3	0	0	0	0	0	0	0
Ephemeroptera	Baetidae	*Baetis*	14	50	34	48	42	20	23	29	59	49	16	37
Ephemeroptera	Caenidae	*Caenis*	104	43	151	42	82	25	17	24	77	60	36	77
Ephemeroptera	Heptageniidae	*Ecdyonurus*	2	15	2	12	2	18	10	12	21	18	11	4
Ephemeroptera	Ephemerellidae	*Ephemerella*	244	225	408	225	254	189	135	221	370	404	391	265
Trichoptera	Ecnomidae	-	0	0	0	1	0	0	0	0	0	0	0	0
Trichoptera	Goeridae	-	0	0	0	0	0	0	1	0	0	0	0	0
Trichoptera	Hydropsychidae	-	21	25	92	41	49	14	7	22	78	35	151	39
Trichoptera	Hydroptilidae	-	5	0	3	0	2	0	0	0	0	0	3	2
Trichoptera	Lepidostomatidae	-	0	3	1	0	0	0	0	0	0	0	1	1
Trichoptera	Leptoceridae	-	1	0	0	0	1	2	2	1	0	1	0	1
Trichoptera	Psychomyidae	-	88	3	7	178	31	4	3	4	6	3	4	17
Trichoptera	Rhyacophilidae	-	8	6	8	17	7	5	1	2	11	3	7	7
Coleoptera	Elminthidae	-	39	18	29	9	22	1	13	19	48	18	21	17
Diptera	Chironomidae	-	1935	654	2071	3012	1742	485	1299	1017	807	1767	1462	1498
Diptera	Empididae	-	0	0	0	1	0	0	0	0	0	0	0	0
Diptera	Limoniidae	-	0	0	1	1	0	0	0	0	0	1	1	0
Diptera	Simuliidae	-	0	0	0	0	1	0	0	0	1	0	0	0
Odonata	Gomphidae	*Onychogomphus*	4	3	2	0	2	0	1	1	0	2	0	2
Crustacea	Asellidae	-	5	5	3	1	3	1	2	2	7	16	5	1
Crustacea	Gammaridae	-	0	4	0	0	0	0	1	0	0	0	0	0
Crustacea	Niphargidae	-	0	0	0	0	1	0	0	0	0	0	0	0
Gastropoda	Lymnaeidae	-	0	0	0	0	0	0	0	0	0	0	1	0
Gastropoda	Neritidae	-	0	0	0	0	0	0	1	0	0	0	0	0
Gastropoda	Valvatidae	-	1	0	0	0	0	0	0	0	0	0	0	0
Bivalvia	Dreissenidae	-	0	0	0	0	1	0	0	0	0	0	0	0
Irudinea	Erpobdellidae	*Dina*	0	0	0	0	0	0	0	0	0	0	1	0
Irudinea	Erpobdellidae	*Erpobdella*	2	0	0	0	1	1	1	1	1	1	0	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	2	0	1	1	6	0	0	1	0	2	0	0
Turbellaria	Dugesiidae	*Dugesia*	1	0	1	3	9	2	3	0	0	0	9	0
Turbellaria	Planariidae	*Polycelis*	0	0	0	0	2	0	0	0	0	0	0	0
Oligocaeta	Lumbricidae	-	3	3	0	0	0	1	1	0	5	7	4	2
Oligocaeta	Lumbriculidae	-	0	0	0	0	1	0	0	0	0	0	0	0
Oligocaeta	Naididae	-	57	0	104	536	541	4	0	43	3	22	108	301
Oligocaeta	Tubificidae	-	0	0	1	0	0	0	0	0	0	0	0	0
Other taxa	Hydracarina	-	8	0	0	3	15	2	1	1	0	1	0	0
Other taxa	Mermithidae	-	3	0	5	1	6	0	0	0	0	1	1	0

Table 66 Absolute abundances (n° individuals / $0.05 m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC1, on 2011/06/15 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	Family	Genus	MAC1	MAC2	MAC3	MAC4	MAC5	MES1	MES2	MES3	MES4	MES5	MES6	MES7
Plecoptera	Leuctridae	*Leuctra*	3	5	1	12	12	0	3	1	0	21	13	4
Ephemeroptera	Baetidae	*Baetis*	42	167	121	146	164	4	115	92	0	117	74	22
Ephemeroptera	Caenidae	*Caenis*	0	3	6	2	1	2	4	0	50	1	2	1
Ephemeroptera	Heptageniidae	*Ecdyonurus*	0	9	3	5	3	2	9	1	3	8	6	4
Ephemeroptera	Ephemerellidae	*Ephemerella*	5	16	20	7	6	5	24	1	4	18	17	5
Trichoptera	Ecnomidae	-	0	0	0	1	0	0	0	0	0	0	0	1
Trichoptera	Goeridae	-	0	4	3	0	1	0	18	0	0	24	11	0
Trichoptera	Hydropsychidae	-	9	119	67	54	193	9	116	34	36	45	24	22
Trichoptera	Hydroptilidae	-	3	3	5	0	1	1	15	0	0	0	1	3
Trichoptera	Lepidostomatidae	-	0	0	0	0	0	0	1	0	0	1	2	0
Trichoptera	Leptoceridae	-	2	2	1	1	0	1	0	0	0	1	1	1
Trichoptera	Psychomyidae	-	2	3	1	0	1	0	20	0	0	0	1	1
Trichoptera	Rhyacophilidae	-	3	19	18	32	10	0	22	12	5	15	8	0
Coleoptera	Dryopidae	-	0	0	0	0	0	1	0	0	0	0	0	0
Coleoptera	Elminthidae	-	9	13	18	4	0	6	20	6	1	13	4	4
Diptera	Chironomidae	-	22	27	16	6	17	51	48	3	2	14	3	51
Diptera	Empididae	-	1	0	1	0	1	1	5	0	0	0	0	0
Diptera	Limoniidae	-	0	0	0	0	0	1	3	0	1	0	0	2
Diptera	Simuliidae	-	0	1	1	0	2	0	0	1	4	0	0	0
Odonata	Gomphidae	*Onychogomphus*	0	0	1	0	0	2	3	0	1	0	2	4
Crustacea	Asellidae	-	16	53	4	0	2	185	17	1	0	10	3	4
Crustacea	Gammaridae	-	0	1	0	0	2	1	1	0	0	2	1	1
Gastropoda	Lymnaeidae	-	0	0	0	0	1	3	0	0	0	0	0	1
Gastropoda	Physidae	-	0	0	0	0	0	1	0	0	0	0	0	0
Gastropoda	Planorbidae	-	0	0	0	0	0	1	0	0	0	0	1	0
Gastropoda	Valvatidae	-	0	0	0	0	0	0	0	0	0	0	1	0
Bivalvia	Dreissenidae	-	0	1	1	0	0	0	0	0	0	0	1	0
Bivalvia	Corbiculidae	-	1	3	5	0	0	0	0	0	0	1	0	0
Irudinea	Erpobdellidae	*Dina*	3	4	1	0	0	14	5	1	0	0	2	1
Irudinea	Erpobdellidae	*Erpobdella*	0	5	0	0	0	1	0	0	0	0	0	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	10	4	4	0	0	0	20	0	0	1	0	2
Turbellaria	Dugesiidae	*Dugesia*	2	2	6	2	0	7	12	2	2	6	0	3
Turbellaria	Planariidae	*Polycelis*	1	0	0	0	0	4	12	1	0	1	0	2
Oligocaeta	Lumbricidae	-	2	3	12	2	11	10	8	1	1	0	3	0
Oligocaeta	Naididae	-	0	0	0	0	0	2	0	0	0	7	0	0
Other taxa	Hydracarina	-	0	0	0	0	0	0	0	0	0	0	0	1

Table 67 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC1, on 2011/09/09 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**
Plecoptera	Leuctridae	*Leuctra*	1	3	1	10	16	2	7	22	16	5	25	12
Ephemeroptera	Baetidae	*Baetis*	16	143	117	91	52	1	166	46	70	44	134	103
Ephemeroptera	Caenidae	*Caenis*	10	17	13	3	3	4	39	9	2	3	4	1
Ephemeroptera	Heptageniidae	*Ecdyonurus*	0	15	7	4	4	0	8	6	11	1	5	7
Ephemeroptera	Ephemerellidae	*Ephemerella*	1	15	7	4	0	0	9	0	6	10	3	4
Trichoptera	Ecnomidae	-	0	0	0	0	0	0	1	0	0	0	6	0
Trichoptera	Goeridae	-	0	0	0	1	0	0	0	5	7	1	3	1
Trichoptera	Hydropsychidae	-	41	355	306	199	99	7	679	147	192	102	232	361
Trichoptera	Hydroptilidae	-	0	6	2	9	2	5	0	0	0	4	50	1
Trichoptera	Lepidostomatidae	-	0	0	1	1	0	0	0	0	0	0	2	0
Trichoptera	Leptoceridae	-	0	0	0	0	0	1	0	0	0	1	0	0
Trichoptera	Psychomyidae	-	0	8	0	6	11	0	0	0	0	11	8	1
Trichoptera	Rhyacophilidae	-	0	14	16	10	2	0	6	4	0	11	6	6
Coleoptera	Elminthidae	-	0	1	5	11	6	8	4	13	4	12	19	27
Diptera	Chironomidae	-	88	15	46	51	35	43	165	30	34	53	102	54
Diptera	Empididae	-	0	0	0	0	0	0	1	0	0	0	0	0
Diptera	Limoniidae	-	2	0	0	2	1	0	3	1	0	4	0	1
Diptera	Simuliidae	-	0	6	1	0	2	0	0	0	0	0	0	0
Odonata	Gomphidae	*Onychogomphus*	1	0	0	0	0	0	1	0	2	1	1	0
Crustacea	Asellidae	-	0	0	0	0	0	0	4	0	0	0	0	0
Crustacea	Gammaridae	-	0	0	0	0	0	1	0	0	1	0	0	0
Gastropoda	Neritidae	-	0	0	0	2	1	0	0	0	0	1	0	0
Gastropoda	Planorbidae	-	0	0	0	0	0	1	0	0	0	0	0	0
Bivalvia	Dreissenidae	-	0	0	0	0	0	0	0	2	0	1	0	0
Bivalvia	Corbiculidae	-	0	1	0	2	0	0	0	0	4	2	2	0
Irudinea	Erpobdellidae	*Erpobdella*	0	0	2	0	0	0	1	1	2	0	0	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	3	0	9	0	0	3	3	3	0	0	1	0
Turbellaria	Dugesiidae	*Dugesia*	0	6	4	14	6	12	0	0	2	6	26	10
Turbellaria	Planariidae	*Polycelis*	1	0	0	0	0	0	0	0	1	0	0	0
Oligocaeta	Lumbricidae	-	1	0	0	9	16	0	4	12	16	18	12	44
Oligocaeta	Lumbriculidae	-	0	0	0	0	0	1	0	0	4	1	0	11
Oligocaeta	Naididae	-	4	0	0	3	0	19	0	4	0	3	2	1
Other taxa	Hydracarina	-	0	1	0	0	0	0	1	0	0	0	0	0

Table 68 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC1, on 2011/12/07 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**
Ephemeroptera	Baetidae	*Baetis*	7	170	88	73	39	0	0	4	0	66	20	81
Ephemeroptera	Caenidae	*Caenis*	7	13	26	14	13	6	9	1	5	30	7	10
Ephemeroptera	Heptageniidae	*Ecdyonurus*	3	1	1	0	0	0	1	0	1	0	0	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	0	1	0	1	0	0	0	0	0	1	1	1
Trichoptera	Goeridae	-	0	0	0	2	0	4	0	2	0	0	0	0
Trichoptera	Hydropsychidae	-	38	347	57	211	45	18	27	40	14	156	34	54
Trichoptera	Hydroptilidae	-	1	6	0	6	0	0	0	0	0	0	0	0
Trichoptera	Lepidostomatidae	-	0	2	0	0	0	1	0	0	0	0	0	0
Trichoptera	Leptoceridae	-	0	0	0	0	0	0	1	0	0	0	0	0
Trichoptera	Psychomyidae	-	6	46	17	35	22	6	4	3	9	26	28	44
Trichoptera	Rhyacophilidae	-	3	14	7	12	8	3	1	4	2	19	8	13
Coleoptera	Elminthidae	-	22	20	59	27	27	8	13	2	14	62	35	15
Diptera	Chironomidae	-	157	378	382	346	214	36	37	82	410	253	220	392
Diptera	Limoniidae	-	0	0	0	0	0	13	2	0	0	0	2	0
Diptera	Simuliidae	-	10	10	2	1	0	0	2	0	3	2	0	3
Crustacea	Asellidae	-	10	1	9	0	0	4	11	1	1	0	0	0
Crustacea	Gammaridae	-	0	0	0	0	0	1	1	0	0	0	0	0
Gastropoda	Hydrobioidaea	-	0	0	14	0	0	0	0	0	0	0	0	0
Gastropoda	Neritidae	-	0	0	0	0	0	1	0	0	0	0	0	1
Gastropoda	Physidae	-	0	0	0	0	0	1	0	0	0	0	0	0
Bivalvia	Dreissenidae	-	0	1	0	10	0	0	0	0	0	0	1	2
Bivalvia	Corbiculidae	-	0	0	2	2	0	0	0	0	0	2	1	2
Irudinea	Erpobdellidae	*Erpobdella*	1	0	0	0	0	0	0	0	0	1	1	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	1	1	1	0	0	2	0	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	4	2	0	2	3	0	1	0	0	1	3	2
Turbellaria	Planariidae	*Polycelis*	0	0	0	0	0	2	1	0	0	0	0	0
Oligocaeta	Lumbricidae	-	2	5	5	3	6	0	5	8	0	7	5	1
Oligocaeta	Lumbriculidae	-	0	0	0	0	0	0	0	0	0	0	1	0
Other taxa	Hydracarina	-	1	0	0	1	0	3	0	0	0	0	0	0
Other taxa	Mermithidae	-	0	1	0	0	0	0	0	0	0	0	0	0

Table 69 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC4, on 2011/02/10 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**	**MES8**
Ephemeroptera	Baetidae	*Baetis*	7	3	10	3	7	0	8	27	0	3	4	1	17
Ephemeroptera	Caenidae	*Caenis*	79	43	40	7	35	3	20	91	17	39	67	16	70
Ephemeroptera	Heptageniidae	*Ecdyonurus*	0	0	1	0	0	0	4	1	1	2	0	0	2
Ephemeroptera	Ephemerellidae	*Ephemerella*	11	8	26	11	27	0	60	36	21	15	25	27	47
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	0	0	0	0	0	0	0	0	0	1	0
Trichoptera	Hydropsychidae	-	51	40	90	22	45	1	18	155	24	55	54	43	76
Trichoptera	Hydroptilidae	-	1	0	0	0	0	0	0	1	3	0	0	0	0
Trichoptera	Lepidostomatidae	-	5	0	0	0	3	0	2	3	1	0	2	0	0
Trichoptera	Leptoceridae	-	2	0	1	0	0	0	1	1	1	0	3	0	2
Trichoptera	Limnephilidae	-	0	0	0	0	0	0	0	0	0	0	0	3	0
Trichoptera	Psychomyidae	-	95	100	46	26	51	0	13	110	51	30	38	25	1
Trichoptera	Rhyacophilidae	-	3	2	0	0	1	0	1	2	2	5	1	2	3
Coleoptera	Dryopidae	-	2	4	2	0	4	0	0	0	1	0	4	0	0
Coleoptera	Elminthidae	-	42	5	4	1	4	0	3	8	1	3	4	2	5
Coleoptera	Gyrinidae	-	0	0	0	0	0	0	0	0	0	0	0	1	0
Diptera	Chironomidae	-	187	253	169	193	255	11	238	349	207	259	233	164	264
Diptera	Empididae	-	1	0	0	0	0	0	0	0	0	0	0	0	1
Diptera	Limoniidae	-	4	2	1	0	1	0	1	5	4	2	1	3	0
Diptera	Simuliidae	-	0	1	7	0	1	0	3	1	0	1	2	1	7
Odonata	Gomphidae	*Onychogomphus*	1	0	1	0	2	0	0	2	0	0	0	0	0
Crustacea	Asellidae	-	0	0	0	0	0	0	1	0	0	0	0	0	0
Crustacea	Gammaridae	-	5	6	4	1	4	4	19	19	18	6	7	6	14
Gastropoda	Bythiniidae	-	0	0	0	0	0	0	0	0	0	0	0	0	1
Gastropoda	Lymnaeidae	-	1	0	0	0	0	0	0	0	0	1	0	2	0
Gastropoda	Physidae	-	0	0	1	0	0	0	2	0	0	1	0	0	0
Bivalvia	Sphaeriidae	-	0	0	0	0	0	0	0	0	0	0	0	0	1
Turbellaria	Dugesiidae	*Dugesia*	7	3	4	1	3	0	9	9	9	3	8	6	4
Oligocaeta	Enchytraeidae	-	1	5	0	0	4	0	0	4	0	0	0	0	0
Oligocaeta	Lumbricidae	-	24	6	0	0	20	0	1	17	1	1	4	0	0
Oligocaeta	Lumbriculidae	-	1	3	0	0	2	0	0	9	1	0	3	0	0
Oligocaeta	Naididae	-	4	17	30	4	25	0	25	17	19	10	18	9	5
Oligocaeta	Propappidae	-	1	0	0	0	0	0	0	0	0	1	0	0	0
Oligocaeta	Tubificidae	-	0	0	0	0	2	0	0	0	0	1	0	0	0
Other taxa	Hydracarina	-	0	2	0	0	0	0	2	5	1	0	4	5	0
Other taxa	Tetrastemmatidae	*Prostoma*	0	0	0	0	1	0	0	0	0	0	0	0	0
Other taxa	Mermithidae	-	0	2	1	0	0	0	1	1	0	2	2	4	0

Table 70 Absolute abundances (n° individuals / 0.05m^2) of macroinvertebrate *taxa* found in Ticino river, site TIC4, on 2011/03/04 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**	**MES8**
Ephemeroptera	Baetidae	*Baetis*	2	6	1	2	41	0	5	6	10	2	3	18	20
Ephemeroptera	Caenidae	*Caenis*	33	50	22	16	130	32	23	46	36	77	49	70	179
Ephemeroptera	Heptageniidae	*Ecdyonurus*	0	1	2	0	6	0	0	0	0	0	1	3	8
Ephemeroptera	Ephemerellidae	*Ephemerella*	4	19	35	19	110	11	27	71	71	63	45	111	256
Ephemeroptera	Heptageniidae	*Heptagenia*	0	1	0	0	2	0	0	0	0	0	0	0	0
Trichoptera	Ecnomidae	-	0	0	0	0	0	0	0	0	2	1	0	0	0
Trichoptera	Goeridae	-	0	0	0	0	0	0	0	0	0	0	0	1	0
Trichoptera	Hydropsychidae	-	56	141	33	23	121	14	68	79	63	55	78	158	49
Trichoptera	Hydroptilidae	-	0	0	0	2	0	1	0	2	5	1	1	0	0
Trichoptera	Lepidostomatidae	-	0	0	0	0	0	0	0	3	0	4	3	3	0
Trichoptera	Leptoceridae	-	0	0	0	0	3	0	0	3	0	2	1	2	0
Trichoptera	Odontoceridae	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	Psychomyidae	-	100	47	7	56	30	19	65	101	77	57	37	206	120
Trichoptera	Rhyacophilidae	-	1	3	0	1	5	2	1	0	1	2	0	4	7
Coleoptera	Dryopidae	-	0	0	0	6	8	1	0	2	0	4	1	0	7
Coleoptera	Elminthidae	-	3	5	2	6	23	1	0	3	3	2	1	13	19
Diptera	Chironomidae	-	237	94	234	196	240	75	152	256	290	254	146	415	251
Diptera	Empididae	-	0	0	0	0	0	0	0	0	1	1	0	2	1
Diptera	Limoniidae	-	3	2	0	4	2	1	2	9	4	3	1	9	3
Diptera	Simuliidae	-	0	0	0	0	0	0	0	1	2	0	1	1	2
Odonata	Gomphidae	*Onychogomphus*	0	0	0	0	5	0	1	2	2	1	0	1	5
Crustacea	Gammaridae	-	4	1	2	0	16	8	0	18	5	8	2	31	84
Gastropoda	Lymnaeidae	-	0	0	0	0	0	0	0	0	0	0	1	0	2
Gastropoda	Physidae	-	0	0	0	0	0	0	0	0	0	2	0	0	0
Gastropoda	Planorbidae	-	0	0	0	0	0	0	0	0	1	0	0	0	0
Bivalvia	Pisidiidae	-	0	0	0	0	1	0	0	0	0	0	0	0	0
Bivalvia	Corbiculidae	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	0	0	0	0	0	0	1	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	5	0	5	7	7	3	8	13	7	18	18	28	11
Oligocaeta	Enchytraeidae	-	0	0	0	0	0	0	0	4	6	2	0	0	0
Oligocaeta	Lumbricidae	-	11	4	0	3	22	0	3	31	1	0	1	21	24
Oligocaeta	Lumbriculidae	-	0	0	1	1	10	0	0	5	10	1	0	3	0
Oligocaeta	Naididae	-	0	0	5	103	7	3	0	10	177	150	24	77	39
Other taxa	Hydracarina	-	0	0	0	0	1	0	0	3	3	1	1	16	2
Other taxa	Mermithidae	-	0	1	0	3	0	0	0	6	5	0	0	1	0

Table 71 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC4, on 2011/04/07 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**	**MES8**
Plecoptera	Leuctridae	*Leuctra*	2	0	0	0	1	0	0	0	1	0	0	0	0
Ephemeroptera	Baetidae	*Baetis*	24	89	36	80	61	25	15	28	81	92	22	26	22
Ephemeroptera	Caenidae	*Caenis*	6	12	2	8	5	8	1	8	33	5	0	8	6
Ephemeroptera	Heptageniidae	*Ecdyonurus*	5	8	8	11	56	11	12	15	27	11	19	33	4
Ephemeroptera	Ephemerellidae	*Ephemerella*	138	164	62	121	81	102	74	112	56	183	59	80	61
Trichoptera	Hydropsychidae	-	4	18	12	16	25	5	4	18	33	15	28	23	8
Trichoptera	Hydroptilidae	-	0	0	2	2	0	0	0	0	0	1	0	1	2
Trichoptera	Lepidostomatidae	-	0	0	1	0	0	0	0	1	0	0	0	0	0
Trichoptera	Leptoceridae	-	0	1	0	0	0	0	0	0	1	0	0	1	0
Trichoptera	Psychomyidae	-	4	3	2	1	3	1	0	2	7	1	0	1	0
Trichoptera	Rhyacophilidae	-	0	3	0	4	6	2	0	3	1	2	2	4	3
Coleoptera	Elminthidae	-	0	1	1	3	12	5	5	5	12	7	4	2	0
Diptera	Chironomidae	-	264	413	262	199	102	188	157	207	251	451	178	188	238
Diptera	Simuliidae	-	0	4	2	1	1	1	0	0	6	1	0	0	0
Diptera	Tabanidae	-	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea	Asellidae	-	0	0	0	0	0	0	0	1	0	0	0	0	1
Crustacea	Gammaridae	-	8	7	6	9	10	8	2	4	11	7	1	3	0
Turbellaria	Dugesiidae	*Dugesia*	0	0	0	3	0	0	0	2	1	0	0	0	0
Oligocaeta	Enchytraeidae	-	0	0	0	0	0	0	0	2	0	0	0	0	0
Oligocaeta	Lumbriculidae	-	0	0	0	0	0	0	0	2	3	0	0	0	0
Oligocaeta	Naididae	-	41	75	14	63	4	24	6	15	16	93	7	16	23

Table 72 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC4, on 2011/06/15 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**	**MES8**
Plecoptera	Leuctridae	*Leuctra*	10	18	14	6	9	3	8	28	31	17	11	28	2
Ephemeroptera	Baetidae	*Baetis*	28	283	166	70	62	1	14	181	106	273	209	143	26
Ephemeroptera	Caenidae	*Caenis*	0	0	1	0	0	0	0	0	0	1	0	4	2
Ephemeroptera	Heptageniidae	*Ecdyonurus*	1	3	2	0	7	0	1	7	11	6	6	6	3
Ephemeroptera	Ephemerellidae	*Ephemerella*	0	2	3	2	1	0	4	14	10	6	1	6	0
Ephemeroptera	Heptageniidae	*Heptagenia*	0	0	0	0	0	0	0	0	0	0	0	2	0
Trichoptera	Ecnomidae	-	1	15	0	0	0	0	1	4	1	1	12	1	1
Trichoptera	Hydropsychidae	-	10	178	57	88	76	4	6	59	22	33	102	92	31
Trichoptera	Hydroptilidae	-	0	0	0	0	0	0	1	0	0	0	0	1	1
Trichoptera	Lepidostomatidae	-	0	0	0	0	1	0	0	0	2	2	0	1	0
Trichoptera	Psychomyidae	-	6	12	0	0	0	3	6	6	2	2	7	13	10
Trichoptera	Rhyacophilidae	-	2	9	8	11	1	1	3	3	6	1	7	1	1
Coleoptera	Elminthidae	-	2	1	1	2	2	1	3	1	5	2	2	2	0
Diptera	Chironomidae	-	121	302	52	91	52	54	92	141	191	173	211	139	109
Diptera	Empididae	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Diptera	Limoniidae	-	0	0	0	0	0	0	0	2	0	0	0	1	0
Diptera	Simuliidae	-	0	7	0	10	0	0	0	1	0	0	0	0	0
Diptera	Tipulidae	-	0	1	0	1	0	0	0	0	0	0	0	0	0
Odonata	Gomphidae	*Onychogomphus*	0	0	0	0	0	0	0	0	0	0	0	1	1
Crustacea	Asellidae	-	4	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea	Gammaridae	-	10	14	23	6	1	1	0	20	50	29	29	67	0
Gastropoda	Lymnaeidae	-	0	0	0	0	0	0	0	0	1	0	0	0	0
Gastropoda	Physidae	-	0	0	0	0	0	0	1	0	0	0	0	0	0
Bivalvia	Corbiculidae	-	0	0	0	0	0	0	0	0	1	0	0	0	0
Turbellaria	Dendrocoelidae	*Dendrocoelum*	0	0	0	0	0	0	0	1	0	0	0	0	0
Turbellaria	Dugesiidae	*Dugesia*	0	1	0	0	0	0	1	0	0	1	2	5	5
Oligocaeta	Enchytraeidae	-	0	0	0	0	0	0	0	0	0	0	1	0	0
Oligocaeta	Lumbricidae	-	0	0	0	0	8	0	0	0	0	0	0	0	0
Oligocaeta	Lumbriculidae	-	0	0	0	0	0	0	0	0	1	0	1	0	0
Oligocaeta	Naididae	-	0	0	1	0	0	0	3	5	3	4	3	7	1
Other taxa	Hydracarina	-	0	1	0	0	0	1	0	1	4	0	0	0	1

Table 73 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC4, on 2011/09/09 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**	**MES8**
Plecoptera	Leuctridae	*Leuctra*	7	4	5	41	8	17	11	22	6	4	25	21	56
Ephemeroptera	Baetidae	*Baetis*	31	23	120	42	30	198	123	152	65	7	26	3	19
Ephemeroptera	Caenidae	*Caenis*	27	4	6	137	83	156	53	43	21	7	107	80	123
Ephemeroptera	Heptageniidae	*Ecdyonurus*	0	0	1	1	0	1	2	5	2	2	0	1	0
Ephemeroptera	Ephemerellidae	*Ephemerella*	0	0	1	5	1	2	1	2	2	1	1	1	0
Trichoptera	Ecnomidae	-	0	0	0	0	2	2	1	0	0	0	0	0	0
Trichoptera	Goeridae	-	1	1	0	0	0	0	0	0	0	0	1	0	0
Trichoptera	Hydropsychidae	-	55	27	121	222	48	239	173	172	215	25	25	17	23
Trichoptera	Hydroptilidae	-	3	7	0	2	6	17	0	2	4	0	6	2	3
Trichoptera	Lepidostomatidae	-	4	2	1	0	0	0	0	0	0	0	6	0	0
Trichoptera	Leptoceridae	-	2	0	0	0	2	0	0	0	0	1	2	0	0
Trichoptera	Psychomyidae	-	0	0	8	1	3	8	7	7	19	0	2	0	1
Trichoptera	Rhyacophilidae	-	0	3	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	Elminthidae	-	2	8	1	1	2	3	1	2	9	0	6	1	1
Diptera	Chironomidae	-	234	81	89	161	104	126	64	74	70	90	196	248	81
Diptera	Limoniidae	-	0	1	0	0	1	0	0	0	0	0	0	0	0
Diptera	Simuliidae	-	0	0	0	0	1	0	2	0	2	0	0	0	0
Diptera	Tabanidae	-	0	0	0	0	0	0	0	0	0	0	0	0	1
Odonata	Gomphidae	*Onychogomphus*	1	2	0	1	0	0	0	0	0	0	2	0	0
Crustacea	Asellidae	-	0	2	0	0	0	0	0	0	0	2	4	2	0
Crustacea	Gammaridae	-	0	0	0	9	0	1	0	2	1	0	0	0	2
Irudinea	Erpobdellidae	*Erpobdella*	0	0	0	1	0	0	0	0	0	0	1	1	0
Turbellaria	Dugesiidae	*Dugesia*	5	4	1	0	2	2	2	1	3	0	16	21	4
Oligocaeta	Enchytraeidae	-	0	0	0	2	0	0	0	1	0	0	0	0	0
Oligocaeta	Lumbricidae	-	5	5	0	5	1	0	0	0	2	0	6	6	6
Oligocaeta	Lumbriculidae	-	2	0	0	1	0	0	0	0	0	0	0	0	0
Oligocaeta	Naididae	-	1	6	0	0	2	0	0	0	1	0	0	4	0
Other taxa	Hydracarina	-	0	0	0	0	0	0	0	1	1	0	0	1	0

Table 74 Absolute abundances (n° individuals / $0.05m^2$) of macroinvertebrate *taxa* found in Ticino river, site TIC4, on 2011/12/07 for each subsample (MAC = *macrolithal*, MES = *mesolithal*).

Taxon	**Family**	**Genus**	**MAC1**	**MAC2**	**MAC3**	**MAC4**	**MAC5**	**MES1**	**MES2**	**MES3**	**MES4**	**MES5**	**MES6**	**MES7**	**MES8**
Ephemeroptera	Baetidae	*Baetis*	85	24	63	41	29	5	5	48	15	4	16	125	5
Ephemeroptera	Caenidae	*Caenis*	17	14	81	56	17	9	12	1	9	11	12	37	0
Ephemeroptera	Heptageniidae	*Ecdyonurus*	0	0	0	1	0	0	1	0	1	0	7	2	0
Trichoptera	Goeridae	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	Hydropsychidae	-	225	159	403	364	76	43	25	50	115	42	103	684	21
Trichoptera	Leptoceridae	-	0	0	0	0	0	0	0	0	1	0	0	0	0
Trichoptera	Psychomyidae	-	6	2	0	34	13	15	0	3	2	0	0	13	2
Trichoptera	Rhyacophilidae	-	1	1	0	1	1	0	1	0	2	1	1	1	0
Coleoptera	Elminthidae	-	3	0	6	4	0	1	4	2	0	4	1	12	0
Diptera	Chironomidae	-	274	228	114	101	199	83	89	440	626	249	372	155	182
Diptera	Simuliidae	-	27	31	9	4	1	0	1	69	9	4	7	27	7
Diptera	Tipulidae	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Odonata	Gomphidae	*Onychogomphus*	0	0	0	1	0	0	0	0	0	0	0	0	0
Crustacea	Gammaridae	-	1	0	0	1	0	1	0	0	1	0	0	0	0
Gastropoda	Planorbidae	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Gastropoda	Valvatidae	-	0	0	0	0	0	1	0	0	0	0	0	1	0
Bivalvia	Corbiculidae	-	0	0	0	0	0	0	0	0	0	0	0	2	0
Turbellaria	Dugesiidae	*Dugesia*	0	1	0	0	1	0	0	2	2	0	0	0	0
Oligocaeta	Lumbricidae	-	0	0	1	0	1	1	0	0	0	0	0	2	1
Oligocaeta	Naididae	-	0	2	0	0	0	0	0	0	1	0	0	0	0

Table 75 Physical and hydrological data collected on Adda river for the study of macroinvertebrates, for each subsample.

date	site	subsample	depth (cm)	velocity (m/s)	distance from right bank (m)	distance from left bank (m)	algae	shading	flow type
2011-04-08	ADS2	MES1	5	0.09	83	2.5	1	1	sm
2011-04-08	ADS2	MES2	37	0.41	78	10	1	1	sm
2011-04-08	ADS2	MES3	49	0.61	84	10	0	0	sm
2011-04-08	ADS2	MES4	33	0.71	64	23	0	0	rp
2011-04-08	ADS2	MES5	28	0.61	69	27	0	0	rp
2011-04-08	ADS2	MES6	26	0.6	76	34	1	0	sm
2011-04-08	ADS2	MES7	12	0.6	15	82	1	1	uw
2011-04-08	ADS2	MES8	25	0.62	19	83	1	1	rp
2011-04-08	ADS2	MAC1	16	0.7	78	7	1	0	rp
2011-04-08	ADS2	MAC2	40	0.61	82	16	1	0	rp
2011-04-08	ADS2	MAC3	19	0.57	79	29	1	0	rp
2011-04-08	ADS2	MAC4	7	0.49	7	81	1	1	sm
2011-04-08	ADS2	MAC5	6	0.53	12	90	1	1	uw
2011-04-08	ADS3	MAC1	9	0.09	51	4.5	1	1	sm
2011-04-08	ADS3	MAC2	8	0.21	53	2.5	1	1	sm
2011-04-08	ADS3	MAC3	24	0.4	53	4	1	1	rp
2011-04-08	ADS3	MAC4	28	0.68	48	4.5	1	1	rp
2011-04-08	ADS3	MAC5	13	0.74	65	6	1	0	uw
2011-04-08	ADS3	MAC6	40	0.98	61	8	1	0	rp
2011-04-08	ADS3	MES1	14	0.09	48	1.2	1	1	sm
2011-04-08	ADS3	MES2	20	0.28	58	2	0	1	sm
2011-04-08	ADS3	MES3	12	0.47	67	4.5	0	1	uw
2011-04-08	ADS3	MES4	10	0.84	68	3.5	0	1	uw
2011-04-08	ADS3	MES5	27	0.3	70	1.5	1	1	rp
2011-04-08	ADS6	MES1	46	0.6	29	6	0	0	sm
2011-04-08	ADS6	MES2	47	0.52	29	6	0	0	rp
2011-04-08	ADS6	MES3	34	0.17	32	3	0	0	sm
2011-04-08	ADS6	MES4	64	0.82	27	8	0	0	rp
2011-04-08	ADS6	MES5	30	0.58	37	3	0	0	rp
2011-04-08	ADS6	MES6	49	1.02	37.5	7.5	0	0	rp
2011-04-08	ADS6	MIC1	26	0.55	48	5	0	0	rp
2011-04-08	ADS6	MIC2	34	0.65	49	8	0	0	rp
2011-04-08	ADS6	MIC3	49	0.62	46	10	0	0	rp
2011-04-08	ADS6	MIC4	54	0.92	39	8.5	0	0	sm
2011-04-08	ADS6	MIC5	18	0.45	39	3	0	0	rp
2011-08-23	ADS2	MES1	18	0.6	80	4.8	1	1	uw
2011-08-23	ADS2	MES2	47	0.84	78	6	1	1	uw
2011-08-23	ADS2	MES3	58	0.99	77	12	1	0	uw
2011-08-23	ADS2	MES4	51	0.94	65	21	0	0	uw
2011-08-23	ADS2	MES5	37	0.96	53	31	0	0	uw
2011-08-23	ADS2	MES6	45	0.82	37	48	0	0	uw
2011-08-23	ADS2	MES7	36	0.96	21	75	0	0	uw
2011-08-23	ADS2	MES8	25	0.56	3	81	0	1	uw
2011-08-23	ADS2	MAC1	18	0.69	82	3.5	0	1	uw
2011-08-23	ADS2	MAC2	35	1.31	76	8	1	1	uw
2011-08-23	ADS2	MAC3	48	1.02	62	23	0	0	uw
2011-08-23	ADS2	MAC4	35	0.92	34	51	0	0	uw
2011-08-23	ADS2	MAC5	33	1.08	15	71	0	1	uw
2011-08-23	ADS3	MAC1	30	0.74	73	2	0	1	uw
2011-08-23	ADS3	MAC2	10	0.36	80	1	0	0	uw
2011-08-23	ADS3	MAC3	25	0.3	76	3	0	0	uw
2011-08-23	ADS3	MAC4	50	1.14	73	6	0	0	uw
2011-08-23	ADS3	MAC5	30	0.91	61	12	0	0	bw
2011-08-23	ADS3	MES1	14	0.01	74	1	1	1	sm
2011-08-23	ADS3	MES2	40	0.65	78	2.8	0	0	uw
2011-08-23	ADS3	MES3	58	1.19	76	4	0	0	uw
2011-08-23	ADS3	MES4	50	0.82	67	13	0	0	bw
2011-08-23	ADS3	MES5	50	0.52	82	2	1	1	uw
2011-08-23	ADS3	MES6	50	1.1	78	3	0	1	uw
2011-08-25	ADS6	MES1	5	0.08	38	2	0	0	rp
2011-08-25	ADS6	MES2	10	0.42	34	4	1	0	rp
2011-08-25	ADS6	MES3	27.5	0.8	31	7	1	0	rp
2011-08-25	ADS6	MES4	35	0.97	32	12	1	0	rp
2011-08-25	ADS6	MES5	45	1.05	28	16	0	0	rp
2011-08-25	ADS6	MES6	8	0.36	37	2.5	1	0	rp
2011-08-25	ADS6	MIC1	5	0.15	38	2	0	0	rp
2011-08-25	ADS6	MIC2	20	0.67	37	5	0	0	rp
2011-08-25	ADS6	MIC3	41	0.98	30	13	0	0	rp
2011-08-25	ADS6	MIC4	52	1.22	27	17	0	0	rp
2011-08-25	ADS6	MIC5	12	0.32	36	3.5	1	0	rp

Table 76 Physical and chemical parameters measured for the study of fluvial functionality in Ticino river, sites *Maddalena*, *Mazzini* and *Porto*. Used units: conductivity (µS/cm); O_2conc (= oxygen concentration: mg/l); O_2sat (= oxygen saturation; %); T and Tair (respectively water and air temperature: °C); BOD_5, COD. N-NH_4, N-NO_2, N-NO_3, P-PO_4, TP, TN, SST (mg/l). For conductivity, dissolved oxygen, water temperature and pH median values are presented.

year	date	measure	parameter	Maddalena	Mazzini	Porto
2010	April 1st	pre-dawn	conductivity	nodata	168.85	168.2
2010	April 1st	morning	conductivity	nodata	168.9	168.2
2010	April 1st	midday	conductivity	nodata	168.7	168.1
2010	April 1st	afternoon	conductivity	nodata	168.6	167.95
2010	April 1st	sunset	conductivity	nodata	168.5	167.9
2010	April 1st	pre-dawn	O2conc	nodata	11.755	11.71
2010	April 1st	morning	O2conc	nodata	11.815	12.03
2010	April 1st	midday	O2conc	nodata	13.11	nodata
2010	April 1st	afternoon	O2conc	nodata	13.23	13.34
2010	April 1st	sunset	O2conc	nodata	13.26	13.16
2010	April 1st	pre-dawn	O2sat	nodata	102.8	102.2
2010	April 1st	morning	O2sat	nodata	103.35	105.5
2010	April 1st	midday	O2sat	nodata	115	nodata
2010	April 1st	afternoon	O2sat	nodata	117.15	118.55
2010	April 1st	sunset	O2sat	nodata	116.8	115.7
2010	April 1st	pre-dawn	pH	nodata	7.765	7.855
2010	April 1st	morning	pH	nodata	7.905	7.945
2010	April 1st	midday	pH	nodata	7.995	8.07
2010	April 1st	afternoon	pH	nodata	8.155	8.185
2010	April 1st	sunset	pH	nodata	8.145	8.16
2010	April 1st	pre-dawn	T	nodata	8.4	8.4
2010	April 1st	morning	T	nodata	8.4	8.6
2010	April 1st	midday	T	nodata	8.6	8.8
2010	April 1st	afternoon	T	nodata	9	9.2
2010	April 1st	sunset	T	nodata	8.8	8.8
2010	April 1st	pre-dawn	BOD5	nodata	1.30	nodata
2010	April 1st	morning	BOD5	nodata	0.99	1.23
2010	April 1st	midday	BOD5	nodata	1.60	1.20
2010	April 1st	afternoon	BOD5	nodata	1.10	1.10
2010	April 1st	sunset	BOD5	nodata	1.00	1.20
2010	April 1st	pre-dawn	COD	nodata	nodata	nodata
2010	April 1st	morning	COD	nodata	nodata	nodata
2010	April 1st	midday	COD	nodata	nodata	nodata
2010	April 1st	afternoon	COD	nodata	nodata	nodata
2010	April 1st	sunset	COD	nodata	nodata	nodata
2010	April 1st	pre-dawn	NH4	nodata	0.029	0.023
2010	April 1st	morning	NH4	nodata	0.028	0.024
2010	April 1st	midday	NH4	nodata	0.030	0.027
2010	April 1st	afternoon	NH4	nodata	0.025	0.025
2010	April 1st	sunset	NH4	nodata	0.027	0.028
2010	April 1st	pre-dawn	NO2	nodata	nodata	nodata
2010	April 1st	morning	NO2	nodata	nodata	nodata
2010	April 1st	midday	NO2	nodata	nodata	nodata
2010	April 1st	afternoon	NO2	nodata	nodata	nodata
2010	April 1st	sunset	NO2	nodata	nodata	nodata
2010	April 1st	pre-dawn	NO3	nodata	0.700	0.674
2010	April 1st	morning	NO3	nodata	0.738	0.762
2010	April 1st	midday	NO3	nodata	0.744	0.771
2010	April 1st	afternoon	NO3	nodata	0.743	0.736
2010	April 1st	sunset	NO3	nodata	0.759	0.728
2010	April 1st	pre-dawn	PO4	nodata	<0.01	<0.01
2010	April 1st	morning	PO4	nodata	<0.01	<0.01
2010	April 1st	midday	PO4	nodata	<0.01	<0.01
2010	April 1st	afternoon	PO4	nodata	<0.01	0.012
2010	April 1st	sunset	PO4	nodata	<0.01	<0.01
2010	April 1st	pre-dawn	SST	nodata	1.6	1.7
2010	April 1st	morning	SST	nodata	1.3	1.6
2010	April 1st	midday	SST	nodata	1.7	1.8
2010	April 1st	afternoon	SST	nodata	1.6	1.3
2010	April 1st	sunset	SST	nodata	1.6	1.6
2010	April 1st	pre-dawn	TN	nodata	<1	1.07
2010	April 1st	morning	TN	nodata	1.16	1.08
2010	April 1st	midday	TN	nodata	1.73	1.01
2010	April 1st	afternoon	TN	nodata	1.35	1.42
2010	April 1st	sunset	TN	nodata	1.11	1.08
2010	April 20th	pre-dawn	conductivity	nodata	171.5	169.9
2010	April 20th	morning	conductivity	nodata	171.3	168.5
2010	April 20th	midday	conductivity	nodata	169.7	167.3
2010	April 20th	afternoon	conductivity	nodata	169.3	nodata
2010	April 20th	sunset	conductivity	nodata	169.5	167.8
2010	April 20th	pre-dawn	O2conc	nodata	10.515	10.58
2010	April 20th	morning	O2conc	nodata	11.89	13.66
2010	April 20th	midday	O2conc	nodata	13.955	15.07
2010	April 20th	afternoon	O2conc	nodata	14.105	nodata
2010	April 20th	sunset	O2conc	nodata	13.795	13.98
2010	April 20th	pre-dawn	O2sat	nodata	93.4	93.7
2010	April 20th	morning	O2sat	nodata	105.3	122.2
2010	April 20th	midday	O2sat	nodata	126.8	139.65
2010	April 20th	afternoon	O2sat	nodata	130.25	nodata
2010	April 20th	sunset	O2sat	nodata	127.1	129.6
2010	April 20th	pre-dawn	pH	nodata	7.59	7.73
2010	April 20th	morning	pH	nodata	8.26	8.995
2010	April 20th	midday	pH	nodata	9.2	9.49
2010	April 20th	afternoon	pH	nodata	9.315	nodata
2010	April 20th	sunset	pH	nodata	9.3	9.48
2010	April 20th	pre-dawn	T	nodata	9.3	9.2
2010	April 20th	morning	T	nodata	9.2	9.6
2010	April 20th	midday	T	nodata	10.2	11.1
2010	April 20th	afternoon	T	nodata	10.8	nodata
2010	April 20th	sunset	T	nodata	10.7	11.05
2010	April 20th	pre-dawn	BOD5	nodata	0.80	0.80
2010	April 20th	morning	BOD5	nodata	2.34	1.07
2010	April 20th	midday	BOD5	nodata	0.90	1.04
2010	April 20th	afternoon	BOD5	nodata	1.28	1.28
2010	April 20th	sunset	BOD5	nodata	0.90	nodata
2010	April 20th	pre-dawn	COD	nodata	<5	<5
2010	April 20th	morning	COD	nodata	<5	<5
2010	April 20th	midday	COD	nodata	<5	<5
2010	April 20th	afternoon	COD	nodata	<5	<5
2010	April 20th	sunset	COD	nodata	6.44	<5
2010	April 20th	pre-dawn	NH4	nodata	0.020	0.021
2010	April 20th	morning	NH4	nodata	0.018	0.019
2010	April 20th	midday	NH4	nodata	0.018	0.021
2010	April 20th	afternoon	NH4	nodata	0.018	0.018
2010	April 20th	sunset	NH4	nodata	0.019	0.018
2010	April 20th	pre-dawn	NO2	nodata	<0.0015	<0.0015
2010	April 20th	morning	NO2	nodata	<0.0015	<0.0015
2010	April 20th	midday	NO2	nodata	<0.0015	<0.0015
2010	April 20th	afternoon	NO2	nodata	<0.0015	<0.0015
2010	April 20th	sunset	NO2	nodata	<0.0015	<0.0015
2010	April 20th	pre-dawn	NO3	nodata	0.749	0.718
2010	April 20th	morning	NO3	nodata	0.718	0.665
2010	April 20th	midday	NO3	nodata	0.760	0.702
2010	April 20th	afternoon	NO3	nodata	0.679	0.611
2010	April 20th	sunset	NO3	nodata	0.695	0.662
2010	April 20th	pre-dawn	PO4	nodata	<0.01	<0.01
2010	April 20th	morning	PO4	nodata	<0.01	<0.01
2010	April 20th	midday	PO4	nodata	<0.01	<0.01
2010	April 20th	afternoon	PO4	nodata	<0.01	<0.01
2010	April 20th	sunset	PO4	nodata	<0.01	<0.01
2010	April 20th	pre-dawn	SST	nodata	1.7	2.5
2010	April 20th	morning	SST	nodata	3.1	3.2

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2010	April 20th	midday	SST	nodata	2.5	2.9
2010	April 20th	afternoon	SST	nodata	3.1	2.4
2010	April 20th	sunset	SST	nodata	3.2	2.7
2010	April 20th	pre-dawn	TN	nodata	<1	<1
2010	April 20th	morning	TN	nodata	<1	1.040
2010	April 20th	midday	TN	nodata	1.030	<1
2010	April 20th	afternoon	TN	nodata	<1	<1
2010	April 20th	sunset	TN	nodata	<1	<1
2010	July 27th	pre-dawn	conductivity	nodata	171.7	165.3
2010	July 27th	morning	conductivity	nodata	nodata	164.7
2010	July 27th	midday	conductivity	nodata	168.4	164.9
2010	July 27th	afternoon	conductivity	nodata	170.5	165.45
2010	July 27th	sunset	conductivity	nodata	171.3	165.3
2010	July 27th	pre-dawn	O2conc	nodata	6.225	6.72
2010	July 27th	morning	O2conc	nodata	nodata	9.22
2010	July 27th	midday	O2conc	nodata	10.155	10.46
2010	July 27th	afternoon	O2conc	nodata	10.675	11.915
2010	July 27th	sunset	O2conc	nodata	11.455	9.285
2010	July 27th	pre-dawn	O2sat	nodata	73.05	78.45
2010	July 27th	morning	O2sat	nodata	nodata	109.15
2010	July 27th	midday	O2sat	nodata	119.85	128.1
2010	July 27th	afternoon	O2sat	nodata	130.6	151.45
2010	July 27th	sunset	O2sat	nodata	145.8	113.95
2010	July 27th	pre-dawn	pH	nodata	7.83	7.91
2010	July 27th	morning	pH	nodata	nodata	8.73
2010	July 27th	midday	pH	nodata	9.035	9.27
2010	July 27th	afternoon	pH	nodata	9.255	9.695
2010	July 27th	sunset	pH	nodata	9.5	9.325
2010	July 27th	pre-dawn	T	nodata	22.2	22
2010	July 27th	morning	T	nodata	nodata	22.7
2010	July 27th	midday	T	nodata	22.5	24.6
2010	July 27th	afternoon	T	nodata	24.5	26.1
2010	July 27th	sunset	T	nodata	26.4	24.7
2010	July 27th	pre-dawn	BOD5	nodata	1.45	0.26
2010	July 27th	morning	BOD5	nodata	nodata	1.07
2010	July 27th	midday	BOD5	nodata	2.08	1.40
2010	July 27th	afternoon	BOD5	nodata	3.32	0.42
2010	July 27th	sunset	BOD5	nodata	2.24	1.31
2010	July 27th	pre-dawn	COD	nodata	<5	<5
2010	July 27th	morning	COD	nodata	nodata	<5
2010	July 27th	midday	COD	nodata	<5	<5
2010	July 27th	afternoon	COD	nodata	9.92	<5
2010	July 27th	sunset	COD	nodata	6.28	<5
2010	July 27th	pre-dawn	NH4	nodata	0.049	0.026
2010	July 27th	morning	NH4	nodata	nodata	0.027
2010	July 27th	midday	NH4	nodata	0.040	0.028
2010	July 27th	afternoon	NH4	nodata	0.034	0.026
2010	July 27th	sunset	NH4	nodata	0.031	0.025
2010	July 27th	pre-dawn	NO2	nodata	0.002	0.007
2010	July 27th	morning	NO2	nodata	nodata	0.004
2010	July 27th	midday	NO2	nodata	0.003	0.003
2010	July 27th	afternoon	NO2	nodata	0.007	0.004
2010	July 27th	sunset	NO2	nodata	0.004	0.003
2010	July 27th	pre-dawn	NO3	nodata	0.646	0.630
2010	July 27th	morning	NO3	nodata	nodata	0.584
2010	July 27th	midday	NO3	nodata	0.576	0.538
2010	July 27th	afternoon	NO3	nodata	0.665	0.543
2010	July 27th	sunset	NO3	nodata	0.667	0.542
2010	July 27th	pre-dawn	PO4	nodata	0.017	0.014
2010	July 27th	morning	PO4	nodata	nodata	0.027
2010	July 27th	midday	PO4	nodata	0.025	0.039
2010	July 27th	afternoon	PO4	nodata	0.083	0.012
2010	July 27th	sunset	PO4	nodata	0.020	0.032
2010	July 27th	pre-dawn	SST	nodata	1.7	1.3
2010	July 27th	morning	SST	nodata	nodata	2.5
2010	July 27th	midday	SST	nodata	1.6	1.4
2010	July 27th	afternoon	SST	nodata	1.9	1.86
2010	July 27th	sunset	SST	nodata	1.9	1.7
2010	July 27th	pre-dawn	TN	nodata	1.06	<1
2010	July 27th	morning	TN	nodata	nodata	<1
2010	July 27th	midday	TN	nodata	<1	<1
2010	July 27th	afternoon	TN	nodata	<1	<1
2010	July 27th	sunset	TN	nodata	1.08	<1
2010	May 18th	pre-dawn	conductivity	nodata	160.1	159.7
2010	May 18th	morning	conductivity	nodata	160.1	159.8
2010	May 18th	midday	conductivity	nodata	159.9	159.6
2010	May 18th	afternoon	conductivity	nodata	159.9	159.6
2010	May 18th	sunset	conductivity	nodata	160	160
2010	May 18th	pre-dawn	O2conc	nodata	10.99	10.85
2010	May 18th	morning	O2conc	nodata	11.08	11.025
2010	May 18th	midday	O2conc	nodata	nodata	nodata
2010	May 18th	afternoon	O2conc	nodata	nodata	11.125
2010	May 18th	sunset	O2conc	nodata	11.14	11
2010	May 18th	pre-dawn	O2sat	nodata	104.1	102.4
2010	May 18th	morning	O2sat	nodata	105.1	104.8
2010	May 18th	midday	O2sat	nodata	nodata	nodata
2010	May 18th	afternoon	O2sat	nodata	nodata	108.2
2010	May 18th	sunset	O2sat	nodata	107.5	106.6
2010	May 18th	pre-dawn	pH	nodata	7.665	7.775
2010	May 18th	morning	pH	nodata	7.75	7.79
2010	May 18th	midday	pH	nodata	7.73	7.805
2010	May 18th	afternoon	pH	nodata	7.595	7.835
2010	May 18th	sunset	pH	nodata	7.825	7.88
2010	May 18th	pre-dawn	T	nodata	12.3	12.1
2010	May 18th	morning	T	nodata	12.3	12.4
2010	May 18th	midday	T	nodata	12.5	12.7
2010	May 18th	afternoon	T	nodata	12.8	13.2
2010	May 18th	sunset	T	nodata	13	13.2
2010	May 18th	pre-dawn	BOD5	nodata	1.10	0.40
2010	May 18th	morning	BOD5	nodata	0.00	0.20
2010	May 18th	midday	BOD5	nodata	0.90	0.70
2010	May 18th	afternoon	BOD5	nodata	0.80	0.50
2010	May 18th	sunset	BOD5	nodata	0.93	0.60
2010	May 18th	pre-dawn	COD	nodata	<5	<5
2010	May 18th	morning	COD	nodata	<5	<5
2010	May 18th	midday	COD	nodata	<5	<5
2010	May 18th	afternoon	COD	nodata	<5	<5
2010	May 18th	sunset	COD	nodata	<5	<5
2010	May 18th	pre-dawn	NH4	nodata	0.028	0.030
2010	May 18th	morning	NH4	nodata	0.032	0.027
2010	May 18th	midday	NH4	nodata	0.034	0.028
2010	May 18th	afternoon	NH4	nodata	0.038	0.025
2010	May 18th	sunset	NH4	nodata	0.033	0.025
2010	May 18th	pre-dawn	NO2	nodata	nodata	nodata
2010	May 18th	morning	NO2	nodata	nodata	nodata
2010	May 18th	midday	NO2	nodata	nodata	nodata
2010	May 18th	afternoon	NO2	nodata	nodata	nodata
2010	May 18th	sunset	NO2	nodata	nodata	nodata
2010	May 18th	pre-dawn	NO3	nodata	0.750	0.782
2010	May 18th	morning	NO3	nodata	0.739	0.781
2010	May 18th	midday	NO3	nodata	0.777	0.770
2010	May 18th	afternoon	NO3	nodata	0.775	0.763
2010	May 18th	sunset	NO3	nodata	0.739	0.780
2010	May 18th	pre-dawn	PO4	nodata	0.080	0.047
2010	May 18th	morning	PO4	nodata	0.026	0.048
2010	May 18th	midday	PO4	nodata	0.052	0.029
2010	May 18th	afternoon	PO4	nodata	0.021	0.040
2010	May 18th	sunset	PO4	nodata	0.075	0.014
2010	May 18th	pre-dawn	SST	nodata	3.0	2.0
2010	May 18th	morning	SST	nodata	4.0	2.0
2010	May 18th	midday	SST	nodata	3.0	2.0
2010	May 18th	afternoon	SST	nodata	2.0	2.0
2010	May 18th	sunset	SST	nodata	3.0	2.0
2010	May 18th	pre-dawn	TN	nodata	<1	<1
2010	May 18th	morning	TN	nodata	<1	<1
2010	May 18th	midday	TN	nodata	<1	<1
2010	May 18th	afternoon	TN	nodata	<1	<1
2010	May 18th	sunset	TN	nodata	<1	<1
2010	May 25th	pre-dawn	conductivity	nodata	158.1	157.35
2010	May 25th	morning	conductivity	nodata	158.9	157.8
2010	May 25th	midday	conductivity	nodata	158.55	158.5
2010	May 25th	afternoon	conductivity	nodata	159.9	158.4
2010	May 25th	afternoon	conductivity	nodata	159.8	158.4
2010	May 25th	sunset	conductivity	nodata	160	158.7
2010	May 25th	pre-dawn	O2conc	nodata	9.555	9.46
2010	May 25th	morning	O2conc	nodata	9.84	10.265
2010	May 25th	midday	O2conc	nodata	10.325	10.715
2010	May 25th	afternoon	O2conc	nodata	10.485	10.8
2010	May 25th	afternoon	O2conc	nodata	10.53	10.63
2010	May 25th	sunset	O2conc	nodata	9.955	9.795
2010	May 25th	pre-dawn	O2sat	nodata	93.65	92.5
2010	May 25th	morning	O2sat	nodata	96.55	101.2
2010	May 25th	midday	O2sat	nodata	103.1	108.7
2010	May 25th	afternoon	O2sat	nodata	106.6	111.5

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2010	May 25th	afternoon	O2sat	nodata	107.5	109.3
2010	May 25th	sunset	O2sat	nodata	100.75	98.8
2010	May 25th	pre-dawn	pH	nodata	7.65	7.73
2010	May 25th	morning	pH	nodata	7.69	7.775
2010	May 25th	midday	pH	nodata	nodata	nodata
2010	May 25th	afternoon	pH	nodata	8.53	8.585
2010	May 25th	afternoon	pH	nodata	8.615	8.7
2010	May 25th	sunset	pH	nodata	8.535	8.325
2010	May 25th	pre-dawn	T	nodata	13.5	13.5
2010	May 25th	morning	T	nodata	13.6	13.9
2010	May 25th	midday	T	nodata	14.4	15.1
2010	May 25th	afternoon	T	nodata	15.2	15.9
2010	May 25th	afternoon	T	nodata	15.3	15.7
2010	May 25th	sunset	T	nodata	14.9	14.8
2010	May 25th	pre-dawn	BOD5	nodata	0.82	1.26
2010	May 25th	morning	BOD5	nodata	0.76	0.72
2010	May 25th	midday	BOD5	nodata	1.94	1.28
2010	May 25th	afternoon	BOD5	nodata	1.34	1.03
2010	May 25th	afternoon	BOD5	nodata	0.80	0.92
2010	May 25th	sunset	BOD5	nodata	0.93	0.89
2010	May 25th	pre-dawn	COD	nodata	<5	<5
2010	May 25th	morning	COD	nodata	<5	<5
2010	May 25th	midday	COD	nodata	<5	<5
2010	May 25th	afternoon	COD	nodata	<5	<5
2010	May 25th	afternoon	COD	nodata	<5	<5
2010	May 25th	sunset	COD	nodata	<5	<5
2010	May 25th	pre-dawn	NH4	nodata	0.031	0.023
2010	May 25th	morning	NH4	nodata	0.029	0.022
2010	May 25th	midday	NH4	nodata	0.038	0.021
2010	May 25th	afternoon	NH4	nodata	0.027	0.019
2010	May 25th	afternoon	NH4	nodata	0.020	0.018
2010	May 25th	sunset	NH4	nodata	0.024	0.019
2010	May 25th	pre-dawn	NO2	nodata	nodata	nodata
2010	May 25th	morning	NO2	nodata	nodata	nodata
2010	May 25th	midday	NO2	nodata	nodata	nodata
2010	May 25th	afternoon	NO2	nodata	nodata	nodata
2010	May 25th	afternoon	NO2	nodata	nodata	nodata
2010	May 25th	sunset	NO2	nodata	nodata	nodata
2010	May 25th	pre-dawn	NO3	nodata	0.691	0.743
2010	May 25th	morning	NO3	nodata	0.747	0.699
2010	May 25th	midday	NO3	nodata	0.689	0.660
2010	May 25th	afternoon	NO3	nodata	0.633	0.642
2010	May 25th	afternoon	NO3	nodata	0.726	0.692
2010	May 25th	sunset	NO3	nodata	0.720	0.694
2010	May 25th	pre-dawn	PO4	nodata	<0.01	0.049
2010	May 25th	morning	PO4	nodata	0.098	0.030
2010	May 25th	midday	PO4	nodata	0.016	<0.01
2010	May 25th	afternoon	PO4	nodata	<0.01	<0.01
2010	May 25th	afternoon	PO4	nodata	<0.01	<0.01
2010	May 25th	sunset	PO4	nodata	<0.01	<0.01
2010	May 25th	pre-dawn	SST	nodata	2.0	0.0
2010	May 25th	morning	SST	nodata	3.3	1.7
2010	May 25th	midday	SST	nodata	1.0	1.2
2010	May 25th	afternoon	SST	nodata	2.2	1.3
2010	May 25th	afternoon	SST	nodata	1.2	1.0
2010	May 25th	sunset	SST	nodata	1.5	1.8
2010	May 25th	pre-dawn	TN	nodata	<1	<1
2010	May 25th	morning	TN	nodata	<1	<1
2010	May 25th	midday	TN	nodata	<1	<1
2010	May 25th	afternoon	TN	nodata	<1	<1
2010	May 25th	afternoon	TN	nodata	1.100	1.090
2010	May 25th	sunset	TN	nodata	<1	<1
2011	August 18th	pre-down	conductivity	121.4	129.6	126.2
2011	August 18th	morning	conductivity	nodata	130.15	125.7
2011	August 18th	midday	conductivity	124	129.3	125.7
2011	August 18th	afternoon	conductivity	nodata	129.1	125.1
2011	August 18th	sunset	conductivity	nodata	125.5	122.8
2011	August 18th	pre-down	O2conc	7.575	6.645	6.76
2011	August 18th	morning	O2conc	nodata	7.27	8.97
2011	August 18th	midday	O2conc	7.62	8.635	9.61
2011	August 18th	afternoon	O2conc	nodata	9.53	9.215
2011	August 18th	sunset	O2conc	nodata	8.74	7.7
2011	August 18th	pre-down	O2sat	88	76.35	77.6
2011	August 18th	morning	O2sat	nodata	83.5	105.55
2011	August 18th	midday	O2sat	88.1	101	116.25
2011	August 18th	afternoon	O2sat	nodata	114.6	112.05
2011	August 18th	sunset	O2sat	nodata	104.4	91.25

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2011	August 18th	pre-down	pH	8.035	7.29	7.12
2011	August 18th	morning	pH	nodata	7.32	7.97
2011	August 18th	midday	pH	7.63	7.98	8.24
2011	August 18th	afternoon	pH	nodata	7.82	8.27
2011	August 18th	sunset	pH	nodata	8.25	7.98
2011	August 18th	pre-down	T	22.8	22.2	22.2
2011	August 18th	morning	T	nodata	22.2	23.5
2011	August 18th	midday	T	22.6	23.2	25
2011	August 18th	afternoon	T	nodata	24.6	25.3
2011	August 18th	sunset	T	nodata	24.3	23.8
2011	August 18th	pre-down	Tair	nodata	nodata	21.3
2011	August 18th	morning	Tair	nodata	nodata	28.8
2011	August 18th	midday	Tair	nodata	nodata	32.1
2011	August 18th	afternoon	Tair	nodata	nodata	29.2
2011	August 18th	sunset	Tair	nodata	nodata	22.0
2011	August 18th	pre-dawn	BOD5	3.56	3.24	1.56
2011	August 18th	pre-dawn	BOD5	nodata	1.73	1.55
2011	August 18th	midday	BOD5	2.00	2.87	3.07
2011	August 18th	afternoon	BOD5	nodata	0.37	1.78
2011	August 18th	sunset	BOD5	nodata	2.06	2.53
2011	August 18th	pre-dawn	NH4	0.029	0.026	0.038
2011	August 18th	morning	NH4	nodata	0.025	0.018
2011	August 18th	midday	NH4	0.024	0.020	<0.015
2011	August 18th	afternoon	NH4	nodata	0.019	<0.015
2011	August 18th	sunset	NH4	nodata	<0.015	0.019
2011	August 18th	pre-dawn	NO3	0.375	0.539	0.637
2011	August 18th	morning	NO3	nodata	0.866	0.569
2011	August 18th	midday	NO3	0.313	0.634	0.337
2011	August 18th	afternoon	NO3	nodata	0.524	0.457
2011	August 18th	sunset	NO3	nodata	0.409	0.378
2011	August 18th	pre-dawn	TP	0.014	<0.01	0.016
2011	August 18th	morning	TP	nodata	0.042	0.012
2011	August 18th	midday	TP	0.016	<0.01	<0.01
2011	August 18th	afternoon	TP	nodata	0.017	<0.01
2011	August 18th	sunset	TP	nodata	0.011	<0.01
2011	August 18th	pre-dawn	SST	1.20	1.29	1.13
2011	August 18th	morning	SST	nodata	1.13	1.25
2011	August 18th	midday	SST	1.29	1.13	1.06
2011	August 18th	afternoon	SST	nodata	1.00	1.38
2011	August 18th	sunset	SST	nodata	1.18	1.25
2011	August 18th	pre-dawn	TN	<1	1.170	2.110
2011	August 18th	morning	TN	nodata	1.280	<1
2011	August 18th	midday	TN	<1	1.070	<1
2011	August 18th	afternoon	TN	nodata	<1	<1
2011	August 18th	sunset	TN	nodata	<1	1.340
2011	August 19th	pre-down	conductivity	127.45	137.7	132.85
2011	August 19th	afternoon	conductivity	nodata	130.2	128
2011	August 19th	pre-down	O2conc	8.33	6.315	6.38
2011	August 19th	afternoon	O2conc	nodata	9.19	9.34
2011	August 19th	pre-down	O2sat	98.95	73.95	73.9
2011	August 19th	afternoon	O2sat	nodata	110.25	115.65
2011	August 19th	pre-down	pH	7.755	7	6.98
2011	August 19th	afternoon	pH	nodata	7.96	8.23
2011	August 19th	pre-down	T	23.9	23.3	22.6
2011	August 19th	midday	T	nodata	nodata	25.2
2011	August 19th	afternoon	T	nodata	24.5	26.3
2011	August 19th	pre-down	Tair	nodata	nodata	20.1
2011	August 19th	midday	Tair	nodata	nodata	28.9
2011	August 19th	afternoon	Tair	nodata	nodata	30.8
2011	August 19th	pre-dawn	BOD5	1.14	1.55	1.09
2011	August 19th	afternoon	BOD5	nodata	2.10	1.34
2011	August 19th	pre-dawn	NH4	0.021	0.022	0.022
2011	August 19th	afternoon	NH4	nodata	0.027	<0.015
2011	August 19th	pre-dawn	NO3	0.575	0.457	0.433
2011	August 19th	afternoon	NO3	nodata	0.635	0.447
2011	August 19th	pre-dawn	Ptot	<0.01	0.011	0.026
2011	August 19th	afternoon	Ptot	nodata	0.019	0.017
2011	August 19th	pre-dawn	SST	0.95	1.00	nodata
2011	August 19th	afternoon	SST	nodata	1.13	1.00
2011	August 19th	pre-dawn	TN	<1	<1	<1
2011	August 19th	afternoon	TN	nodata	<1	1.010
2011	August 31st	pre-down	conductivity	129.7	137.9	133.7
2011	August 31st	afternoon	conductivity	130.35	135	131
2011	August 31st	sunset	conductivity	136.6	135.6	132.5
2011	August 31st	pre-down	O2conc	8.75	6.905	6.69
2011	August 31st	afternoon	O2conc	8.1	10.54	10.67
2011	August 31st	sunset	O2conc	11.165	10.205	7.43

year	date	measure	parameter	Maddalena	Mazzini	Porto
2011	August 31st	pre-down	O2sat	102.2	79.05	75.9
2011	August 31st	afternoon	O2sat	92.4	123.35	128.35
2011	August 31st	sunset	O2sat	131.95	121.25	86.35
2011	August 31st	pre-down	pH	8.03	7.385	7.09
2011	August 31st	afternoon	pH	7.66	8.33	8.575
2011	August 31st	sunset	pH	8.02	8.53	8.15
2011	August 31st	pre-down	T	23.1	22.1	21.6
2011	August 31st	afternoon	T	21.8	23.15	24.7
2011	August 31st	sunset	T	23.7	24	22.85
2011	August 31st	afternoon	Tair	nodata	nodata	26.3
2011	August 31st	sunset	Tair	nodata	nodata	18.8
2011	August 31st	pre-dawn	BOD5	nodata	0.91	0.91
2011	August 31st	afternoon	BOD5	0.70	1.26	1.23
2011	August 31st	sunset	BOD5	1.39	0.71	1.16
2011	August 31st	pre-dawn	NH4	<0.015	<0.015	0.040
2011	August 31st	afternoon	NH4	<0.015	<0.015	<0.015
2011	August 31st	sunset	NH4	<0.015	<0.015	<0.015
2011	August 31st	pre-dawn	NO3	0.539	0.457	0.443
2011	August 31st	afternoon	NO3	0.317	0.484	0.426
2011	August 31st	sunset	NO3	0.479	0.961	0.432
2011	August 31st	pre-dawn	TP	0.023	<0.01	0.015
2011	August 31st	afternoon	TP	0.047	0.014	0.020
2011	August 31st	sunset	TP	<0.01	0.028	<0.01
2011	August 31st	pre-dawn	SST	nodata	nodata	nodata
2011	August 31st	afternoon	SST	nodata	nodata	nodata
2011	August 31st	sunset	SST	nodata	nodata	nodata
2011	August 31st	pre-dawn	TN	<1	<1	1.410
2011	August 31st	afternoon	TN	<1	<1	1.150
2011	August 31st	sunset	TN	<1	1.280	<1
2011	September 1st	pre-down	conductivity	130	133	129.6
2011	September 1st	afternoon	conductivity	130.1	133.6	129
2011	September 1st	sunset	conductivity	123.9	130.8	127.9
2011	September 1st	pre-down	O2conc	7.51	7.09	6.535
2011	September 1st	afternoon	O2conc	8.88	10.425	10.925
2011	September 1st	sunset	O2conc	10.19	9.945	7.87
2011	September 1st	pre-down	O2sat	86.6	81.1	74.35
2011	September 1st	afternoon	O2sat	101.85	121.55	130.9
2011	September 1st	sunset	O2sat	120.4	118	92.3
2011	September 1st	pre-down	pH	7.45	7.31	7.045
2011	September 1st	afternoon	pH	7.78	8.325	8.5
2011	September 1st	sunset	pH	8.31	8.335	8.16
2011	September 1st	pre-down	T	22.4	22	21.7
2011	September 1st	afternoon	T	22.1	23	24.5
2011	September 1st	sunset	T	23.7	23.9	23.3
2011	September 1st	pre-down	Tair	nodata	nodata	18.0
2011	September 1st	afternoon	Tair	nodata	nodata	27.7
2011	September 1st	sunset	Tair	nodata	nodata	20.7
2011	September 1st	pre-dawn	BOD5	1.49	0.88	1.20
2011	September 1st	afternoon	BOD5	1.18	2.07	1.18
2011	September 1st	sunset	BOD5	1.55	1.10	1.24
2011	September 1st	pre-dawn	NH4	<0.015	<0.015	<0.015
2011	September 1st	afternoon	NH4	<0.015	<0.015	<0.015
2011	September 1st	sunset	NH4	<0.015	0.018	<0.015
2011	September 1st	pre-dawn	NO3	0.461	0.468	0.803
2011	September 1st	afternoon	NO3	0.551	0.966	0.776
2011	September 1st	sunset	NO3	0.767	0.458	0.334
2011	September 1st	pre-dawn	TP	<0.01	<0.01	0.014
2011	September 1st	afternoon	TP	0.063	0.029	0.017
2011	September 1st	sunset	TP	0.030	<0.01	<0.01
2011	September 1st	pre-dawn	SST	nodata	nodata	nodata
2011	September 1st	afternoon	SST	nodata	nodata	nodata
2011	September 1st	sunset	SST	nodata	nodata	nodata
2011	September 1st	pre-dawn	TN	<1	<1	<1
2011	September 1st	afternoon	TN	1.070	<1	1.100
2011	September 1st	sunset	TN	1.140	<1	<1
2012	August 22nd	morning	conductivity	161.0	170.0	168.0
2012	August 22nd	sunset	conductivity	161.0	167.0	163.5
2012	August 22nd	pre-dawn	O2conc	nodata	nodata	5.9
2012	August 22nd	morning	O2conc	6.5	8.2	10.1
2012	August 22nd	afternoon	O2conc	nodata	nodata	10.1
2012	August 22nd	sunset	O2conc	9.4	10.2	8.0
2012	August 22nd	pre-dawn	O2sat	nodata	nodata	71.8
2012	August 22nd	morning	O2sat	80.9	101.4	128.2
2012	August 22nd	afternoon	O2sat	nodata	nodata	131.8
2012	August 22nd	sunset	O2sat	119.3	132.3	103.7
2012	August 22nd	morning	pH	7.8	8.3	9.2
2012	August 22nd	sunset	pH	9.0	9.4	9.1

year	date	measure	parameter	Maddalena	Mazzini	Porto
2012	August 22nd	pre-dawn	T	nodata	nodata	24.3
2012	August 22nd	morning	T	25.0	24.5	26.3
2012	August 22nd	afternoon	T	nodata	nodata	27.8
2012	August 22nd	sunset	T	26.7	27.7	27.0
2012	August 22nd	pre-dawn	Tair	nodata	nodata	22.7
2012	August 22nd	morning	Tair	nodata	nodata	35.2
2012	August 22nd	afternoon	Tair	nodata	nodata	31.7
2012	August 22nd	sunset	Tair	nodata	nodata	27.0
2012	August 22nd	morning	BOD5	1.84	1.08	2.08
2012	August 22nd	sunset	BOD5	2.73	1.60	1.95
2012	August 22nd	morning	NH4	<0.015	<0.015	<0.015
2012	August 22nd	sunset	NH4	0.021	<0.015	<0.015
2012	August 22nd	morning	NO3	0.396	0.449	0.381
2012	August 22nd	sunset	NO3	0.477	0.402	0.41
2012	August 22nd	morning	PO4	<0.01	<0.01	<0.01
2012	August 22nd	sunset	PO4	<0.01	<0.01	<0.01
2012	August 22nd	morning	TP	0.012	0.093	0.156
2012	August 22nd	sunset	TP	0.032	0.143	0.085
2012	August 24th	morning	conductivity	162.0	169.0	168.0
2012	August 24th	sunset	conductivity	163.0	168.0	164.0
2012	August 24th	pre-dawn	O2conc	nodata	nodata	5.7
2012	August 24th	morning	O2conc	6.1	8.3	9.9
2012	August 24th	afternoon	O2conc	nodata	nodata	9.9
2012	August 24th	sunset	O2conc	9.3	10.8	7.7
2012	August 24th	pre-dawn	O2sat	nodata	nodata	70.2
2012	August 24th	morning	O2sat	76.1	103.0	125.9
2012	August 24th	afternoon	O2sat	nodata	nodata	127.8
2012	August 24th	sunset	O2sat	117.4	139.8	98.0
2012	August 24th	morning	pH	7.8	8.5	9.2
2012	August 24th	sunset	pH	9.1	9.6	9.1
2012	August 24th	pre-dawn	T	nodata	nodata	24.4
2012	August 24th	morning	T	24.7	24.4	26.0
2012	August 24th	afternoon	T	nodata	nodata	27.1
2012	August 24th	sunset	T	26.0	27.2	26.4
2012	August 24th	pre-dawn	Tair	nodata	nodata	19.6
2012	August 24th	morning	Tair	nodata	nodata	31.5
2012	August 24th	afternoon	Tair	nodata	nodata	30.7
2012	August 24th	sunset	Tair	nodata	nodata	24.7
2012	August 24th	morning	BOD5	2.91	1.77	1.89
2012	August 24th	sunset	BOD5	2.04	1.09	2.37
2012	August 24th	morning	NH4	0.019	0.016	<0.015
2012	August 24th	sunset	NH4	<0.015	0.036	0.02
2012	August 24th	morning	NO3	0.412	0.438	0.384
2012	August 24th	sunset	NO3	0.4	0.414	0.428
2012	August 24th	morning	PO4	0.013	<0.01	<0.01
2012	August 24th	sunset	PO4	<0.01	<0.01	<0.01
2012	August 24th	morning	TP	0.038	0.260	0.015
2012	August 24th	sunset	TP	0.020	0.099	0.069