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A first characterization of diatom communities from Trentino streams (Northern Italy)

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INTRODUCTION

The EU Water Framework Directive 2000/60/EC (WFD) (European Parliament 2000) introduces a holistic vision of aquatic ecosystems, considering both biotic and abiotic elements involved in the definition of the quality of the ecosystem. Among biotic parameters, diatoms, as part of the phytobenthos, are one of the most studied groups and are commonly used for river quality assessment in many European countries. In Italy, although the Eutrophication and Pollution Index with Diatoms (EPI-D, Dell'Uomo 2004) has been formulated, knowledge on species ecology and distribution is limited to regional data sets.

This study is a first attempt to identify diatom assemblages characteristic of different river types of the Trentino region (Northern Italy).

MATERIAL & METHODS

Diatoms samples were collected from 67 sites during summer 2004. Different stream typologies have been analysed: Table1 shows the main descriptive parameters of sites.
Standard procedures for diatom sampling and slide preparation were followed (Kelly et al. 1998; European Committee for Standardization 2003). Slides were studied using LM microscope with 1000x magnification, and species were identified according to Krammer & Lange-Bertalot (1991a, b, 1997a, b). At least 400 valves were counted on each slide (European Committee for Standardization 2004). Biotic indices such as the Indice de Polluosensibilité Spécificue (IPS, Coste in Cemagref 1982), the Eutrophication and Pollution Index with Diatoms (EPI-D), the Austrian Saprobic Index (SID, Rott et al. 1997), and the Austrian Trophic Index (TID, Rott et al. 1999) were calculated using OMNIDIA 4.2 software (Lecointe et al. 1993) to assess water quality.
Assemblages composition was analysed with Detrended Correspondence Analyses (PAST software, Hammer et al. 2007) and with the Two Way Indicator Species Analyses (TWINSPAN - PcOrd software 1999). DCA was performed after log transformation of data. For TWINSPAN analyses relative abundances of all species counted were used, and cut levels 0.0, 0.02, 0.05, 0.1, 0.2 were set for pseudospecies definition.

RESULTS

TWINSPAN analyses divides the dataset into two groups, group A is characterized by sites with meso-eutrophic communities, group B with oligotrophic ones (Fig. 1). The most representative species of group A are *Nitzschia fonticola* Grunow, *Cocconeis pediculus* Ehrenb., *Navicula cryptotenella* Lange-Bert., *Navicula tripunctata* (O.F.Müll.) Bory, *Mayamaea atomus* var. *permitis* (Hust.) Lange-Bert., *Didymosphenia geminata* (Lyngb.) M.Schmidt. Group B is characterized by the presence of *Fragilaria arcus* (Ehrenb.) Cleve and *Diatoma mesodon* (Ehrenb.) Kütz.. A further differentiation of group A leads to the definition of a small group C which is characterizing the sites of the River Adige (large, lowland river) with the species *Rhoicosphenia abbreviata* (C.Agardh) Lange-Bert., *Encyonema silesiacum* (Bleisch) D.G.Mann, *Navicula gregaria* Donkin, *Navicula lanceolata* (C.Agardh) Ehrenb., *Achnanthidium atomus* (Hust.) O.Monnier, Lange-Bert. et Ector. Group B is further split into the groups E and F, E being characterized by *Fragilaria capucina* var. *rumpens* (Kütz.)

Lange-Bert., F by *Encyonema minutum* (Hilse) D.G.Mann, *Fragilaria capucina* var. *vaucheriae* (Kütz.) Lange-Bert., *Gomphonema pumilum* (Grunow) E.Reichardt et Lange-Bert. In group E sites of the River Sarca basin with a mainly siliceous and glacial regime can be found, while group F comprises sites of the River Avisio basin with a pluvial-nival regime.

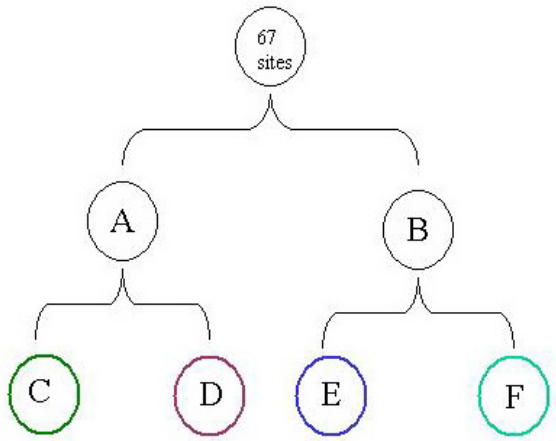

Fig. 1. TWINSPAN groupings.

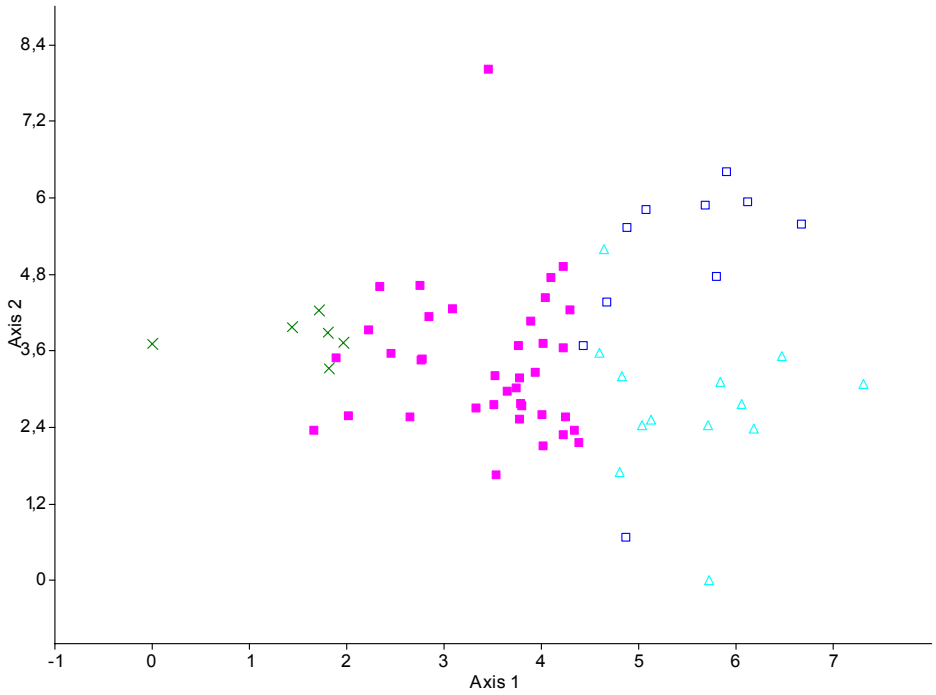

Fig. 2. Detrended Correspondence Analyses. Colours refer to TWINSPAN groupings (see Fig. 1): green x -Group C; filled pink squares –Group D; empty blue squares –Group E; light blue triangulars – Group F.

Similar results are obtained with DCA (Fig. 2). Sites are scattered along the axis 1 mainly according to their trophic status. The group of oligotrophic sites, on the right side of Fig. 1, is moreover spread along axis 2: in the upper part of the graph there are sites representative of group E, in the lower sites of group F.
Table 2 compares the results of quality assessment among four biotic indices; in Table 3 Pearson's correlation among these four indices is reported.

Table 1. Main descriptive parameters of sites.

Sites characteristics		Number of sites
Altitude (m)	800-1600	27
	200-800	30
	<200	10
Distance from source (km)	<5	15
	5-25	30
	25-75	13
	75-150	4
	>150	5
Flow regime	pluvio-nival	51
	glacial	16
Geology	siliceus	24
	calcareus	43
TP (µg l^{-1})	<10	23
	10-30	16
	30-100	19
	>100	9
NO_3 (µg l^{-1})	<600	31
	600-1200	22
	1200-4000	11
	<4000	3

Table 3. Pearson's Correlation among biotic indices (**: p< 0.01).

	IPS	*EPI-D*	*SID*	*TID*
IPS	1			
EPI-D	0.78**	1		
SID	0.83**	0.81**	1	
TID	0.81**	0.87**	0.75**	1

Table 2. Sites quality using different biotic indices.

Watercourse	Site	IPS class	EPI-D class	SID class	TID class
Adige	AD1	II	II	II	eu
	AD2	I	I-II	I-II	meso-eu
	AD3	I	I-II	II	eu
	AD4	I	I-II	II	eu
	AD5	I	I	I-II	meso-eu
	AD6	I	I	I-II	meso-eu
Algone	ALG_M	I	I	I-II	oli
Ambiez	AMB_M	I	I	I-II	oli
	AMB_V	I	I	II	meso-eu
Arno'	ARNO_M	I	I	I-II	oli
	ARNO_V	III	I-II	II-III	eu-poly
Astico	AS1	I	I	II	meso-eu
Avisio	AV1	I	I	II	meso
	AV2	I	I	I-II	meso
	AV3	I	I	I-II	meso-eu
	AV4	I	I	I-II	oli-meso
Bedu' di Pelugo	BEDU_P_M	I	I	I-II	oli
	BEDU_P_V	I	I	I-II	oli-meso
Bedu' S. Valentino	BEDU_SV_M	I	I	I-II	oli
	BEDU_SV_V	I	I	II	meso-eu
Bianco	BI_M	I	I	I-II	meso
	BI_V	I	I	I-II	oli-meso
Brenta	BR1	I	I	I-II	meso
	BR2	II	I-II	II	meso-eu
	BR3	I	I	I-II	meso
Cadino	CAD_M	I	I	I-II	oli
	CAD_V	I	I	I-II	oli
Calvello	CALVELLO	I	I	I-II	meso
Cavelonte	CAV_M	I	I	I-II	oli
	CAV_V	I	I	I-II	oli
Chiese	CH1	I	I	I-II	oli-meso
	CH2	II	II	II	eut
	CH3	I	I	I-II	oli-meso
Cismon	CI1	I	I	I-II	oli-meso
	CI2	I	I	II	meso
Dalo'	DALO_M	II	II	II-III	eu
	DALO_V	II	III	II-III	eu-poly
Diuna	DUINA_FB	I	I	I-II	meso-eu
	DUINA_M	I	I	I-II	oli
	DUINA_V	II	II	II	eu-poly
Fersina	FE1	II	I-II	II	meso-eu
Gardonè	GAR	I	I	I-II	oli
Lagorai	LAG_V	I	I	I-II	ultraoli
Leno	LE1	I	I	I-II	oli-meso
Moena	MOENA	I	I	I-II	oli
Noce	NO1	I	I	I-II	oli-meso
	NO2	I	I	I-II	oli-meso
	NO3	I	I	I-II	oli-meso
	NO4	I	I	I-II	meso-eu
Predaia	PR_M	I	I	I-II	meso
	PR_V	I	I	II	meso
Sarca di Campiglio	SA_CAMP_M	I	I	I-II	meso-eu
	SA_CAMP_V	I	I	I-II	oli-meso
Sarca Val di Genova	SA_GE_M	II	I	II-III	meso-eu
	SA_GE_V	I	I	I-II	oli
Sarca Nambrone	SA_NAM_M	I	I	I-II	oli
Sarca Nambino	SA_NAMBI	I	I	I-II	oli
Sarca	SA_PINZOLO	I	I	I-II	meso-eu
	SA_COMANO	II	II	II	eu
	SA_DARE	I	I	I-II	meso-eu
	SA1	I	I-II	I-II	meso-eu
	SA2	II	II	II	eu
	SA3	I	I-II	II	meso
	SA4	I	I	I-II	meso-eu
	SA_LINFA	I	I	II	meso
Stava	STA_V	I	I	I-II	oli-meso
Vanoi	VA1	I	I	II	meso

DISCUSSION

From the perspective of WFD requirements, this study was intended to analyse diatoms communities and identify assemblages typical of different stream typologies. Multivariate and TWINSPAN analyses show that not only the trophic level, but also flow regime and basin characteristics may influence species composition. The River Adige, for example, is well defined as a separate group; the oligotrophic tributaries of the River Sarca are well distinguished from the River Avisio ones. TWINSPAN analyses can be a useful tool to identify species characteristic of the different stream typologies and eventually of reference conditions.

The application of biotic indices shows that they are well correlated (Table 3; $p < 0.01$), but only the TID reveals the presence of high eutrophic impact, while IPS and EPI-D reach the III class only for eu-polytrophic sites (Table 2). The application of different indices, such as saprobic and trophic ones, can give more detailed information on the pollution sources.

Moreover we underline the presence in some watercourses of *Didymosphenia geminata,* in some countries considered as an invasive species.

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