Diatom-based river monitoring in Umbria (Central Italy): biodiversity and characterization of communities

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INTRODUCTION

Ecological status assessment based on benthic algae communities is one of the new requirement of the WFD 2000/60/EC, implemented in Italy with Legislative Decree 152/2006. In compliance with European and Italian regulations, ARPA Umbria defined specific monitoring programs and networks based on river type definition, anthropic pressures and risk analysis. The aim of the study is to analyze diatom diversity and to identify the characterizing diatoms of different river types.

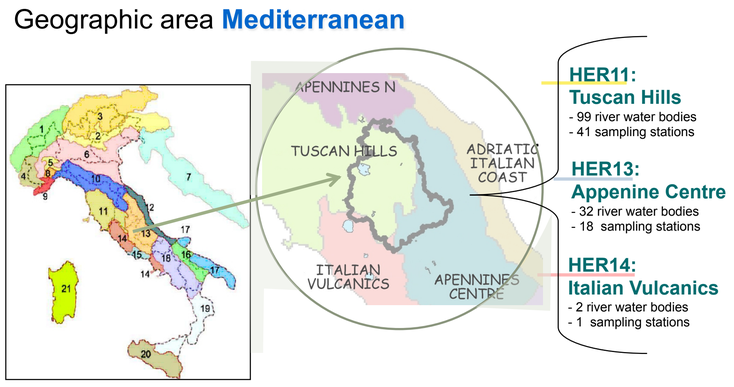


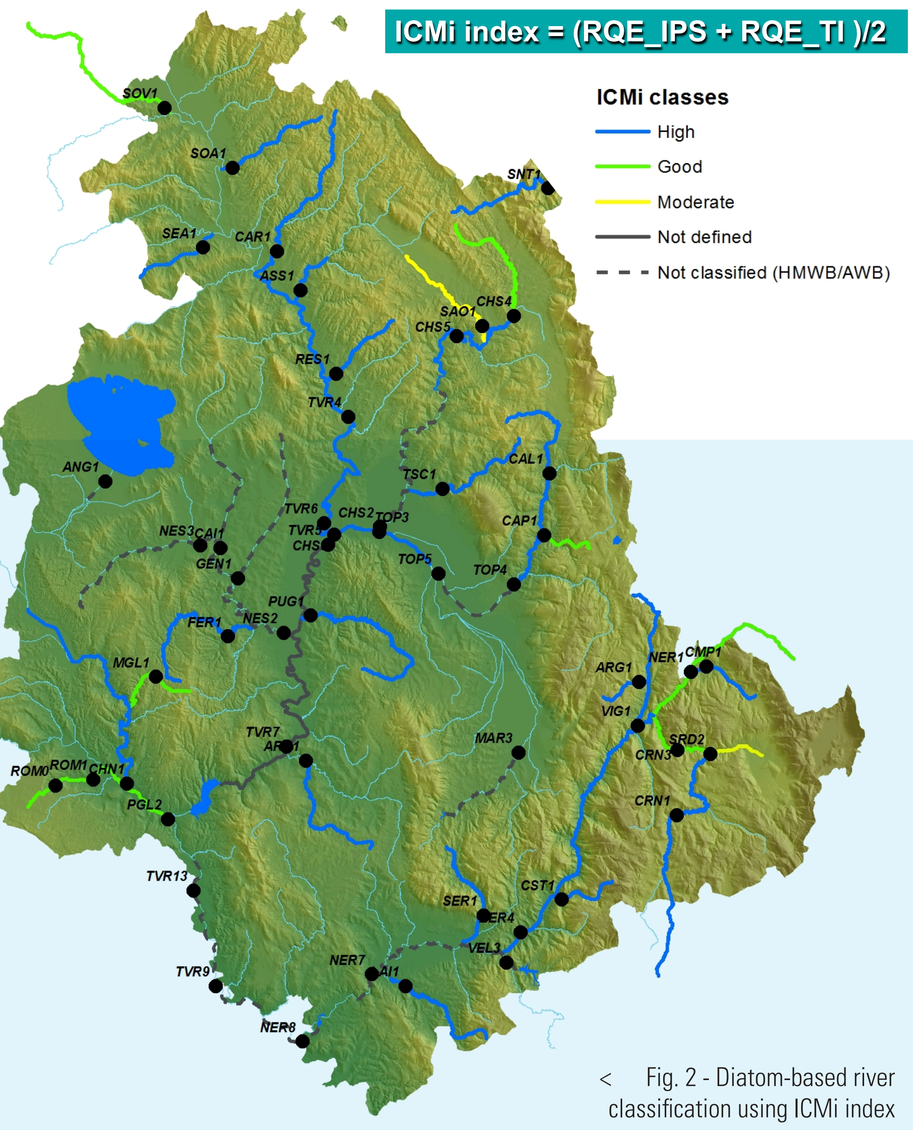
Fig. 1 - Hydroecoregions (HER; WFD 2000/60/CEE) identified according to Basin Authority, Regions, Regional Environamental Agency and Italian Ministry of Environment

STUDY AREA AND METHODS

The Umbria Region (Central Italy) belongs to the Mediterranean area and it's included in three Hydroecoregions (Tuscan Hills, Appennines Centre and Italian Vulcanics, Fig. 1). 133 river waterbodies, belonging to 20 types grouped in five river Mediterranean macrotypes (M1-M5), were identified (Tab. 1). The diatom-based river monitoring network is composed by 52 sampling stations distributed on 36 watercourses. The first benthic diatom communities monitoring cycle ended in 2012; the second one, still in progress, started in 2013.

Macrotype	River Macrotype Description	Number of waterbodies	Sampling sites
M1	Small mid-altitude streams (200-800 m a.s.l.)	47	20
M2	Small and medium lowland streams (<400m a.s.l.)	23	2
M3	Large lowland rivers	10	10
M4	Small and medium mountain streams (400-1500m a.s.l.)	2	2
M5	Small, lowland, temporary (<300m a.s.l.)	51	8

Tab. 1 - River Mediterranean macrotypes identified in the Region

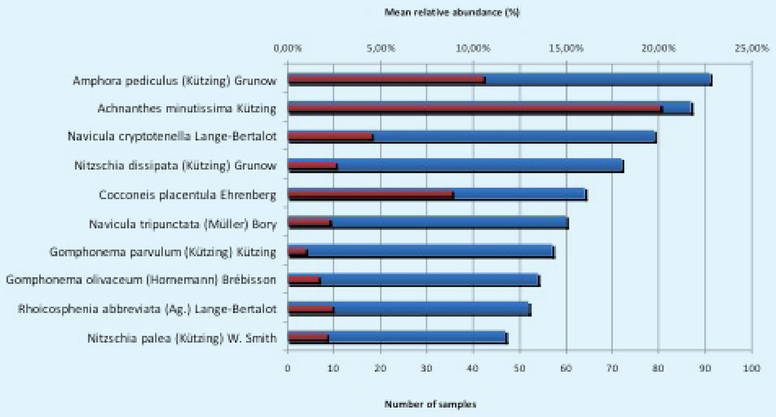


< Fig. 2 - Diatom-based river classification using ICMi index

RESULTS AND DISCUSSION

The first ecological status evaluation based on Intercalibration Common Metric Index (ICMi) classified 36 water bodies (69%) in high or good class (Fig. 2). About 200 diatom species and varieties were identified in about 100 collected sample (41000 counted frustules). The number of species per sample varied from 10 to 38. The most frequent and abundant species is reported in Fig. 3. In order to characterize the diatom species belonging to the Mediterranean river macrotypes, the Indicator Species Analysis (ISA) was used. Each river type showed some typical species (Tab. 2). 42 species (about 20% of the total) were not included in the list of species of the Index (Fig. 4). Two of them are alien species in Italy.

Fig. 3 - Precence and abundance of frequent species



Tab. 2 - Characterizing species of different river types identified by Indicator Species Analysis (ISA)

M1 Small mid-altitude streams	M2 Small and medium lowland streams	M3 Large lowland rivers	M4 Small and medium mountain streams	M5 Small, lowland, temporary
Encyonema silesiacum (Bleisch in Rabh.) D.G.Mann	*Cymatopleura solea* (Brébisson) W.Smith	*Navicula capitatoradiata* Germain	*Denticula tenuis* Kützing	*Fragilaria capitellata* (Grunow in Van Heurck) J.B.Petersen
Achnanthidium pyrenaicum (Hustedt) Kobayasi	*Navicula tripunctata* (Müller) Bory	*Navicula cincta* (Ehrenberg) Ralfs	*Nitzschia palea* (Kützing) W.Smith	*Gomphonema tergestinum* Fricke
Amphora inariensis Krammer	*Gomphonema parvulum* (Kützing) Kützing	*Nitzschia frustulum* (Kützing) Grunow	*Nitzschia fonticola* Grunow	*Achnanthidium minutissimum* (Kützing) Czarnecki
		Navicula cryptotenella Lange-Bertalot	*Encyonema minutum* (Hilse in Rabh.) D.G.Mann	*Encyonpsis microcephala* (Grunow) Krammer
		Navicula cryptocephala Kützing		
		Cyclotella meneghiniana Kützing		

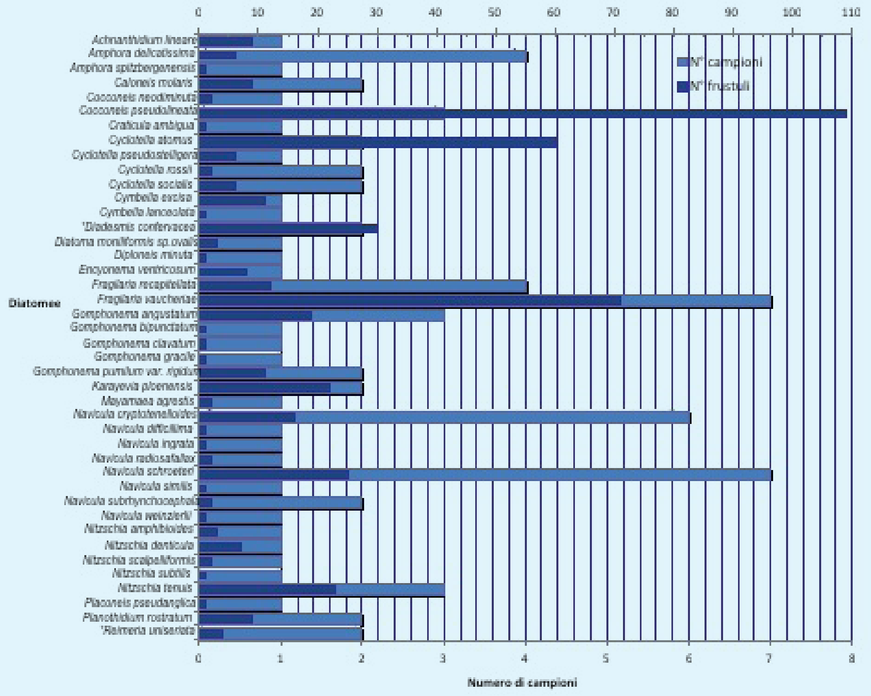


Fig. 4 - Diatom species not included in the TI Rott Index because TW and G values are unknown. TI index is one of two sub – indexes used for ICMi index calculation. Alien species are identified with asterisk.

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Ecological status assessment based on benthic algal communities is one of the new requirements of the European Water Framework Directive 2000/60/EC (EC, 2000), implemented in Italy with Legislative Decree 152/2006. In compliance with the European and Italian regulations, the Environmental Protection Agency of Umbria Region (ARPA Umbria) defined specific monitoring programs and networks based on river type definition, human pressures, and risk analysis. The Umbria Region in central Italy belongs to the Mediterranean area and is included in three Hydro-ecoregions (Tuscan Hills, Appennines Centre and Italian Vulcanics; Wasson *et al*., 2006). 133 river water bodies, belonging to 20 types grouped in five river Mediterranean macrotypes (M1-M5), were identified. The diatom-based river monitoring network is composed by 52 sampling stations distributed on 36 watercourses. The first benthic diatom communities monitoring cycle ended in 2012; the second, still in progress, started in 2013. The aim of this study is to analyse diatom diversity of regional river types and to identify the characterising diatoms of different river types. The first ecological status evaluation based on Intercalibration Common Metric Index (ICMi; Mancini & Sollazzo, 2009) classified 36 water bodies (69%) in high or good class. In the first monitoring cycle about 100 samples were collected and more than 200 diatom species and varieties were identified. The number of species per sample ranged from a minimum of 10 to a maximum of 38 species. The most frequent and abundant species were *Amphora pediculus*, *Achnanthidium minutissimum, Navicula cryptotenella*, *Nitzschia dissipat*a. In order to characterize the diatom species belonging to the five Mediterranean river macrotypes (M1-M5), the Indicator Species Analysis (ISA) was used. Each river type showed some typical species. For example, temporary rivers (M5) are characterized by *Achnanthidium minutissimum*, which is a pioneer and mobile species, capable of a fast river substratum recolonization after repeated annual dry phases. Plain large rivers (M3), instead, are characterized by slow water flow which allows the development of plankonic species that can be also found in benthic communities, like *Cyclotella meneghiniana*.

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