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RESEARCH PAPER

Diversity and Ecology of Algae from Melen River (Western Black Sea River Catchment) in Turkey

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Abstract

Algae are among the key organisms of aquatic ecosystems. While there have been a large number of important algological studies on different river basins in Turkey, the use of algae in biomonitoring is a new approach. Epiphytic and epilithic algae in the Melen River were studied between May 2003 and April 2004. A total of 148 taxa, with 101 belonging to Bacillariophyta, 18 to Chlorophyta, 9 to Charophyta, 13 to Cyanobacteria, 5 to Euglenophyta, and 2 to Miozoa, were identified in this study. Members of Bacillariophyta were the dominant taxa at all sites, with oligohalobious-indifferents and alkaliphiles being the most common. Among the non-diatom taxa, there were more species with oligohalobious-indifferent and indifferent properties. The river water was alkaline and temperate, with low salinity characters. Bio-indications (autecology) of the river were studied. From the results, organic pollution indicators of Watanabe's classification (46 species, 31.1%) constituted three groups (saproxen, eurysaprobe and saprophile). Based on the classification (according to Watanabe's system) and RPI (River Polluted Index), the ecological conditions of Melen River were assessed as low, with a moderate level of organic pollution, and lightly to moderately polluted, respectively.

Keywords: Biomonitoring, diatom, ecological indices, Melen River.

Introduction

Bio-monitoring assessment relies on the variations seen in indicator species and aquatic communities in response to environmental changes, particularly those caused by the polluting agents to which they are exposed. Species that have predictable responses to changes in a selected variable can serve as bio-indicators, reflecting the reactions of aquatic ecosystems to eutrophication, pH levels (acidification), salinity, and organic pollution (Barinova & Krassilov, 2012). Many algal species are indicative of environmental conditions that reflect the effect of hydrochemical variables on aquatic populations.

Diatom and non-diatom communities in similar climatic conditions were studied according to the seasonal influences of environmental factors governing the riverine systems in Greece (Ziller & Montesanto, 2004), Lebanon (Squires & Saoud, 1986), Iran (Atazadeh, Sharifi & Kelly, 2007), Israel (Barinova, Medvedeva & Anissimova, 2006; Barinova, Tavassi & Nevo, 2010a), Georgia (Barinova, Kukhaleishvili, Nevo & Janelidze, 2011a), Italy (Dell'Uomo & Torrisi, 2009), Portugal (Resende, Resende, Pardal, Almeida & Azeiteiro, 2009), and Spain (Blanco, Becares, Cauchie, Hoffmann, & Ector, 2007; Urrea & Sabater, 2009). Bio-indication approaches for river monitoring using algal communities were developed in Israel during the last decade (Barinova, Tavassi & Nevo, 2006a; Barinova, Tavassi, Glassman & Nevo, 2010b; Barinova & Krassilov, 2012; Barinova *et al*. 2016). In bio-monitoring assessments conducted on river ecosystems, the use of algal bio-indicators is becoming more widespread due to changing environmental conditions. Though numerous phycological investigations have been performed in different Turkish river basins, the use of diatoms in biomonitoring (according to diatom indices by OMNIDIA and autecological indices, such as Watanabe's or Van Dam's systems) is relatively new in Turkey (Solak, Ector, Wojtal, Acs & Morales, 2012). We believe that the correct use of bio-indication approaches will contribute significantly to bio-monitoring trials that are still inadequate in the Turkish river systems. The aim of the present study was to establish the diversity of algae in the Melen River by examining the compositions of epilithic and epiphytic algae, their number of species and major

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environmental variables, and revealing autecological status of the river.

Materials and Methods

Melen River runs within Duzce Province, with 80% of its basin of 2317 km^2 confined within the Province (Figure 1). The river rises within Yigilca district boundaries and is fed by Efteni Lake, which has Ugur, Sigirlik, Samandere and Torkul as tributaries from the South and the Asar stream from the east. Melen River takes water from the Aksu Stream and flows through Adapazari Akyazi. It empties into the sea at Akcakoca village, where the mouth of the river is located. Between Düzce and Yigilca lies Hasanlar Dam, initially constructed for irrigation purposes but later converted for hydroelectricity generation. The river has got a complex river system that supports a variety of uses, including irrigation systems in agricultural lands, drinking water and several different industries' wastewater. The return flow from all these users is directly discharged into the river (Doğan, Sengorur & Koklu, 2009). Melen River is named the Small Melen until Lake Efteni, and the Big Melen after Lake Efteni. Descriptions of the Melen River stations are given in Table 1.

Seventy-two samples were collected monthly from 6 stations along the Melen River between May 2003 and April 2004. In parallel with the sampling for epilithic and epiphytic algae, we also collected water samples for the assessment of hydrochemical analysis with phytoplanktonic algae in Melen River as published (Baykal, Açıkgöz, Udoh & Yıldız, 2011). Epiphytic and epilithic samples were collected by scraping the submerged aquatic plants and stones. All samples were fixed by 4% formalin. For the identification of diatoms, frustules were cleaned of subjected to the organic matter with hot concentrated HCl and $KMnO_4$ method described by Taylor, de la

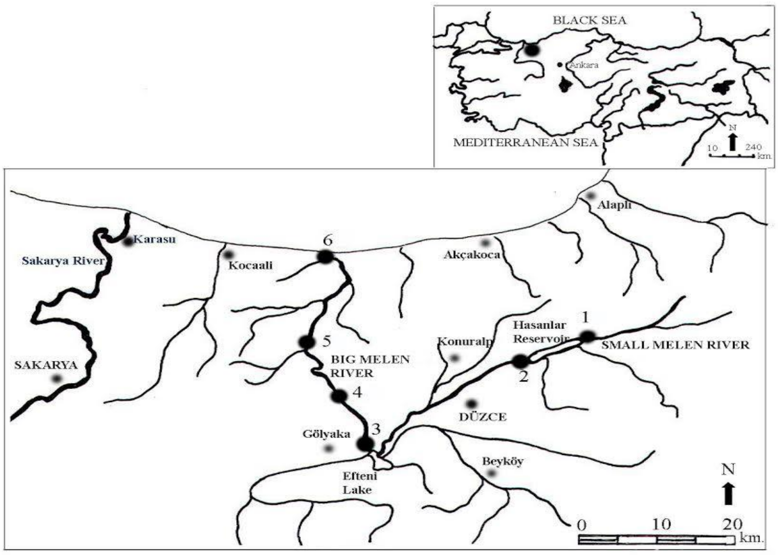

Figure 1. Melen River and sampling stations.

Table 1. Descriptions of Melen River sampling stations

Stations	Descriptions	Coordinate
1	At Aydin village (Düzce-Yığılca), entrance into the dam, withslow waterflow.	40°56'24.3"N 31°20'26.2"E
2	Hasanlar dam regulator exit. Region rich in vegetation along the river.	40°54'53.6"N 31°16'41.9"E
3	Exit in Efteni Lake near Gölyaka (Düzce). qualitatively, the river water here was more turbid than the other stations, probably as a result of the intensive farming and live stock activities in the area.	40°46'25.6"N 31°02'12.7"E
4	Region nearest the settlement area.	40°49'38.6"N 31°01'18.1"E
5	Named Big Melen after exit from Efteni Lake.	40°54'34.2"N 30°56'54.0"E
6*	100 m of Big Melen, where it empties into the Black Sea at Adapazarı (Melen mouth) as the last station.	41°04'19.4"N 30°57'58.6"E

*This station posseses special characteristics due to its brackish nature. Throughout the studies, the highest level of salinity was recorded at this station.

Rey & Van Rensburg (2005) before being mounted in Canada balsam for microscopic observation. Temporary slides for non-diatom taxa and permanent slides for diatoms were examined under microscope (Nikon brand) at a magnification of 400-1000. Different studies from the relevant literature were consulted for species identification (Huber–Pestalozzi, 1982; John, Whitton & Brook, 2002; John & Sheat 2003; Korshikov, 1987; Krammer & Lange–Bertalot, 1991a,b; Krammer & Lange–Bertalot, 1999a,b). There is no specific method for the taxonomical process. After identification, current nomenclature of species was checked on relevant websites like AlgaeBase (Guiry & Guiry, 2017). The ecological data analysis performed for algal species diversity revealed the grouping of freshwater algae in respect to variables that were taken from the database compiled for freshwater algae (Barinova *et al*., 2006). Each group was separately assessed according to its bio-indication significance. Saprobity was investigated according to Watanabe's system, which describes 3 indicator groups: "saproxenes (unpolluted water)", "eurysaprobes (moderately polluted water)", and "polysaprobes (polluted water)" (Watanabe, Asai & Houki, 1986). Pollution index (RPI), (Sumita, 1986) which is currently used by the EPA to conduct river quality assessments (http://wq.epa.gov.tw), was calculated based on dissolved oxygen (DO), biological oxygen demand (BOD), suspended solid (SS) and ammonia-nitrogen. The values of DO, BOD, SS and ammonia-nitrogen were taken from previous publications (Baykal *et al*., 2011).

Results and Discussion

A total of 148 taxa were identified in the Melen River, with *Nitzschia* (16) constituting the highest number in the community, followed by the *Navicula* (13) and *Gomphonema* genus (10) (Table 2).

There were 69 (46.6%) indicator species for streaming and oxygenation, as shown in the diagram, where the species are arranged along the gradient of water flow. Most of the species preferred moderate rates of low water flow (44) as opposed to standing water (13). A majority of the diatom varieties in the Melen River were species typically found in low water flow. A total of six groups of acidophilic indicators constituted 74 (50%) of the species (Figure 2e). In the diagram, these groups are arranged along the pH gradient. The ratio of the groups reflected the influence of carbonate substrates (Barinova *et al*., 2006c; Sládeček, 1986). Alkaliphiles predominated, with 48 species (32.4%). *Achnanthidium minutissimum*, *Cocconeis pediculus*, *Cymbella affinis*, *Diatoma vulgaris*, *Nitzschia palea* and *Ulnaria ulna* were the most prominent among the other species. *C. pediculus*, the most abundant species in the river, was extensively present in the summer months of 2003 at the 2nd and 3rd sites, constituting more than 50% of the species. This species is an epiphytic and cosmopolitan diatom that is found in inland waters with a medium-to-high content of electrolytes and in coastal salt waters (Cox, 1996; Noga *et al*., 2016). Another alkaliphile dominant species, *U. ulna*, is tolerant to water pollution, and its presence in Melen River (>30% of the number at site 1 in July 2004) showed a eutrophic character. It can be found in oligo- to polytrophic and oligo-saprobic to α-mesosaprobic waters (Hofmann, Werum & Lange-Bertalot, 2011). The "indifferents", which usually exist over silicate substrates, were subordinate here, with 19 species. From these species, only *D. vulgaris* was recorded, with 25% relative abundance in epiphyton at site 6 in July 2004. *D. vulgaris* is common in slow-flowing rivers and can often be found in moderately nutrient-rich water conditions (Cox, 1996). Alkalibiontes, which are tolerant to excessive alkalinity, were represented by 2 species (Figure 2a-f). Most of the rivers and streams in Turkey, Europe and nearby phytogeographic realms have an alkaline character (Barinova *et al*., 2006a; Barinova, *et al*., 2010b; Noga *et al*., 2016; Sládeček, 1986). Indicators of salinity (79 species, 53.4%) were assigned to 4 ecological groups and arranged along the gradient of salinity. Mesohalobe and halophilous species (15 species) were recorded at low relative density, while only *Rhoicosphenia abbreviata* was recorded at station 6 (brackish water) at 15% in May 2003. Remarkably, the algal communities of Melen River also contain oligohalobious-indifferents, which prefer temperate, low alkaline, moderately oxygenated freshwater with low-to-middle organic pollution. *Oscillatoria tenuis* and *Oscillatoria limosa* tended to be found more frequently at the lower section with brackish or slightly saline character, and these species have been reported a wide range of salinity (Barinova *et al*., 2016). Furthermore, *R. abbreviata* and *O. limosa* are recognized as being pollution-tolerant species of algae such as *U. ulna* (Das & Chakrabarty, 2007). Among the non-diatom taxa serving as indicators of streaming and oxygenation, species preferring slightly turbulent waters and moderate oxygenation were more prevalent during the sample period. These species included *Cladophora fracta*, *Oedogonium* sp., *Scenedesmus arcuatus* (Chlorophyta), *Cosmarium crenatum*, *Closterium lunula*, *C. moniliferum*, *Spirogyra subsalsa* (Charophyta), *O. tenuis* (Cyanobacteria), *Euglena* sp. and *Phacus cudatus* (Euglenophyta). Many species of the mentioned genus have standing-stream characteristics and wide saprobic tolerance, from oligo-saprobic to meso-saprobic (Barinova *et al.*, 2010a; 2010b; 2011a; Barinova, Nevo & Bragina, 2011b). In fact, most of the species in Table 2 are oligohalobious-indifferent and serve as the indicator species of these ecological conditions.

On the basis of four parameters (DO, BOD, SS and ammonia-nitrogen), the river pollution index (RPI) was calculated according to the data published on the Melen River (Baykal *et al*. 2011). The RPI

Table 2. Ecological classification of studied species

Divizyo: BACILLARIOPHYTA	Hab	T	Reo	D	Hal	pH	Geo
Achnanthidium minutissima var. *gracillima* (Meister) Lange-Bertalot							
Achnanthidium minutissimum (Kützing) Czarnecki	B	eterm	st-str	es	i	alf	k
Amphora ovalis (Kützing) Kützing	P-B	warm	st-str	--	hl	alb	k
Amphora pediculus (Kützing) Grunow ex A.Schmidt	P	--	--	sx	i	alf	k
Asterionella formosa Hassall							
Aulacoseira granulata (Ehrenberg) Simonsen							
Caloneis amphisbaena (Bory) Cleve	B	--	st	sp	i	alf	k
Caloneis ventricosa (Ehrenberg) Meister							
Cocconeis pediculus Ehrenberg	B	--	st-str	sx	i	alf	--
Cocconeis placentula var. *euglypta* (Ehrenberg) Grunow	P-B	temp	st-str	sx	i	alf	--
Cocconeis placentula var. *lineata* (Ehrenberg) Van Heurck	--	--	--	--	hl	alf	k
Craticula cuspidata (Kützing) D.G.Mann	B	temp	st	es	i	alf	--
Craticula halophila (Grunow) D.G.Mann	B	--	st-str	es	mh	alf	--
Cyclostephanos dubius (Fricke in A. Schmidt) Round	P-B	--	st-str	--	i	alf	k
Cyclotella meneghiniana Kützing	B	--	--	--	--	--	k
Cymatopleura elliptica (Brébisson) W.Smith	P-B	--	st-str	--	i	alf	--
Cymatopleura solea (Brébisson) W.Smith	P-B	--	st-str	--	i	alf	--
Cymbella affinis Kützing	B	temp	st-str	sx	i	alf	--
Cymbella cistula (Ehrenberg) Kirchner							
Cymbella helvetica Kützing	B	--	str	sx	i	ind	B
Cymbella lanceolata (Ehrenberg) Kirchner							
Cymbella tumida (Brébisson) V.Heurck							
Cymbopleura amphicephala Näegeli in Kützing	B	--	str	sx	i	ind	--
Denticula elegans Kützing	B	--	--	--	i	alf	--
Diatoma moniliformis (Kützing) D.M.Williams							
Diatoma vulgaris Bory de Saint-Vincent	P-B	--	st-str	sx	i	ind	--
Didymosphenia geminata (Lyngbye) M. Schmidt							
Encyonema caespitosum Kützing							
Encyonema prostratum (Berkeley) Kützing	B	--	st	sx	i	alf	k
Encyonema silesiacum (Bleisch. in Rabenh.) D. G. Mann in Round et al.	B	--	st	sx	i	alf	k
Encyonopsis microcephala (Grunow) Krammer	B	--	--	es	--	alf	k
Encyonopsis minuta Krammer & Reichardt	B	--	--	--	i	ind	--
Epithemia adnata (Kützing) Brébisson	Ep	--	--	--	hl	acf	k
Epithemia sorex Kützing							
Fallacia pygmeae (Kütz.) Stikle et Mann							
Fragilaria capucina var. *vaucheria* (Kützing) Lange-Bertalot							
Fragilaria pulchella (Ralfs ex Kützing) Lange-Bertalot	B	--	str	es	i	alf	b
Frustulia vulgaris (Thwaites) De Toni	P-B	--	st	es	i	alf	--
Gomphonema angustatum (Kützing) Rabenhorst							
Gomphonema acuminatum Ehrenberg							
Gomphonema affine Kützing	P-B	--	st	es	--	--	--
Gomphonema angustum Agardh							
Gomphonema augur Ehrenberg	B	--	aer	--	i	alf	k
Gomphonema clavatum Ehrenberg							
Gomphonema minutum (C.Agardh) C.Agardh	B	--	str	es	i	alf	a-a
Gomphonema olivaceum (Hornemann) Brébisson	B	temp	st-str	es	i	neu	k
Gomphonema parvulum (Kützing) Kützing	B	temp	str	es	i	ind	--
Gomphonema truncatum Ehrenberg	P-B	--	st-str	es	i	alf	--
Gyrosigma acuminatum (Kützing) Rabenhorst	B	cool	st-str	--	i	alf	--
Gyrosigma attenuatum (Kützing) Rabenhorst	P-B	--	st	--	i	alf	--
Gyrosigma scalproides (Rabenhorst) Cleve							
Gyrosigma spencerii (W. Smith) Cleve	B	--	--	es	mh	alf	--
Halamphora veneta (Kützing) Levkov	B	temp	st	sx	i	alf	--
Hippodonta capitata (Ehrenberg) Lange-Bertalot, Metzeltin et Witkowski	B	--	str	es	i	alf	k
Lemnicola hungarica (Grunow) F.E.Round & P.W.Basson	B	--	st	es	--	alf	--
Melosira varians Agardh							
Navicula capitatoradiata Germain							
Navicula cryptocephala Kützing							
Navicula cryptotenella Lange-Bertalot							
Navicula lanceolata Ehrenberg	B	--	st-str	es	i	alf	--
Navicula menisculus Schumann	B	--	st-str	es	i	alf	--
Navicula phyllepta Kützing	P-B, S	temp	st-str	sp	i	alf	k
Navicula pseudonivalis Bock							
Navicula radiosa Kützing	B	temp	st-str	es	i	ind	--
Navicula rhyncocephala Kützing							
Navicula tripunctata (O.F.Müller) Bory de Saint-Vincent	P-B	--	st-str	--	mh	acb	k
Navicula trivialis Lange-Bertalot							
Navicula viridula (Kützing) Ehrenberg	B	--	st-str	--	oh	alf	k
Navicula viridula var. *rostellata* (Kützing) Cleve	B	temp	st-str	sp	hl	alf	k
Neidium dubium (Ehenberg) Cleve	B	--	str	--	i	alf	--
Nitzschia acicularis (Kützing) W. Smith	P-B	temp	--	es	i	alf	--

Table 2. Continued.

	Hab	T	Reo	D	Hal	pH	Geo
Nitzschia capitellata Hust. in A. Schmidt	B	--	--	--	i	ind	b
Nitzschia clausii Hantzsch							
Nitzschia consricta (Kützing) Ralfs in Pritchard							
Nitzschia dissipata (Kützing) Grunow	P-B	temp	st-str	es	mh	ind	k
Nitzschia dissipata var. *media* (Hantzsch) Grunow	--	--	--	sx	i	alf	--
Nitzschia filiformis (Smith) Van Heurck							
Nitzschia fonticola (Grunow) Grunow in Van Heurck	B	--	aer	es	i	ind	k
Nitzschia gracilis Hantzsch	P-B	temp	st-str	sp	i	ind	--
Nitzschia hantzschiana Rabenhorst							
Nitzschia linearis (Agardh) W. Smith	B	temp	st-str	es	i	alf	--
Nitzschia palea (Kützing) W. Smith	P-B	--	--	es	i	alf	k
Nitzschia sigmoidea (Nitzsch) W. Smith	P-B	--	st-str	--	i	alf	--
Nitzschia solita Hustedt							
Nitzschia vermicularis (Kützing) Hantzsch	B	--	str	--	i	alf	--
Pantocsekiella ocellata Pantocsek							
Planothidium lanceolatum (Brébisson ex Kützing) Lange-Bertalot	B	--	--	--	i	alf	k
Reimeria sinuata (Gregory) Kociolek et Stoermer							
Rhoicosphenia abbreviata (C.Agardh) Lange-Bertalot	B	--	st	sx	hl	alf	k
Rhopalodia gibberula (Ehrenberg) O. Müler	B	temp	str	es	mh	ind	--
Sellaphora bacilloides (Hustedt) Z.Levkov, S.Krstic & T.Nakov	B	--	--	--	--	--	k
Sellaphora pupula (Kützing) Mereschkovsky	P-B	--	--	sp	mh	alf	k
Stauroneis smithii Grunow	P-B	--	st-str	--	i	alf	--
Surirella angusta Kützing							
Surirella linearis W. Smith	P-B	--	--	es	i	ind	--
Surirella ovalis Brebisson	P-B	--	st-str	es	mh	alf	--
Tryblionella calida (Grunow) D.G.Mann							
Tryblionella hungarica (Grunow) Frenguelli	P-B	--	--	sp	mh	alf	--
Ulnaria acus (Nitzsch) P.Compère	P	--	st-str	es	i	alb	--
Ulnaria ulna (Kützing) P.Compère	B	temp	st-str	es	i	alf	--
Divizyo: CHLOROPHYTA							
Schizomeris leibleinii Kützing							
Ulothrix sp.							
Stigeoclonium tenue (C.Agardh) Kützing	B	--	st-str	--	--	--	k
Cladophora fracta (O.F.Müller ex Vahl) Kützing	P-B	--	st-str	--	--	--	k
Oedogonium sp.							
Closteriopsis longissima (Lemmermann) Lemmermann							
Characium sp.							
*Coelastrum microporum*Nägeli	P-B	--	st-str	--	i	ind	k
Oocystis borgei J.W.Snow	P-B	--	st-str	--	i	ind	--
Oocystis solitaria Wittrock							
*Tetradesmus lagerheimii*M.J.Wynne& Guiry	P-B	--	st-str	--	i	ind	k
Scenedesmus arcuatus (Lemmermann) Lemmermann	P-B	--	st-str	--	i	--	k
Comasiella arcuata var. platydisca (G.M.Smith) E.Hegewald & M.Wolf							
Tetradesmus obliquus (Turpin) M.J.Wynne	P	--	--	--	i	ind	k
Desmodesmus communis (E.Hegewald) E.Hegewald	P	--	--	--	i	ind	k
Schroederia setigera (Schröder) Lemmermann	P	--	st-str	--	i	--	--
Tetraedron minimum ((A.Braun) Hansgirg	P-B	--	st-str	--	i	--	k
Tetrastrum elegans Playfair	P	--	st-str	--	i	--	k
Phylum:CHAROPHYTA							
Spirogyra dubia Kützing							
Spirogyra subsalsa Kützing							
Closterium closterioides (Ralfs) A.Louis & Peeters							
Closterium lunula Ehrenberg & Hemprich ex Ralfs							
Penium margaritaceum Brébisson							
Closterium moniliferum Ehrenberg ex. Ralfs	P-B	--	st-str	--	i	--	--
Closterium tumidum L.N.Johnson							
Cosmarium crenatum Ralfs ex Ralfs	B	--	aer	--	--	--	--
Cosmarium laeve Rabenhorst	B	--	st-str	--	--	ind	--
Phylum: CYANOBACTERIA							
Cyanophanon minus Geitler							
Merismopedia punctata Meyen	P-B	--	--	--	i	ind	k
Dolichospermum affine (Lemmermann) Wacklin, L.Hoffmann & Komárek							
Leibleinia willei (Setchell & N.L.Gardner) P.C.Silva							
Limnoraphis hieronymusii (Lemmermann) J.Komárek et al.							
Lyngbya martensiana Meneghini ex Gomont							
Porphyrosiphon versicolor (Gomont) Anagnostidis & Komárek							
Kamptonema formosum (Bory ex Gomont) Strunecký, Komárek & J.Smarda	P-B	--	st	--	--	--	--
Pseudanabaena limnetica (Lemmermann) Komárek							
Oscillatoria limosa C.Agardh ex Gomont	P-B	--	st-str	--	hl	--	--
*Oscillatoria planktonica*Woloszynska							
Oscillatoria tenuis C.Agardh ex Gomont	P-B	--	st-str	--	hl	--	--
Phormidium tergestinum (Rabenhorst ex Gomont) Anagnostidis & Komárek	B,S	--	st-str	--	i	--	--

Table 2. Continued.

	Hab	T	Reo	D	Hal	pH	Geo
Phylum: EUGLENOPHYTA							
Lepocinclis acus (O.F.Müller) B.Marin & Melkonian	P	eterm	st	--	i	ind	k
Euglena granulata (G.A.Klebs) F.Schmitz							
Euglena sp.							
Phacus caudatus Hübner	P-B	eterm	st-str	--	i	alf	--
Phacus curvicauda Svirenko	P-B	--	st	--	i	ind	--
Phylum: MIOZOA							
Peridiniopsis quadridens (Stein) Bourrelly	P	--	--	--	--	--	k
Peridinium cinctum (O.F.Müller) Ehrenberg							

Abbreviations: Hab: Habitat, (B: benthic, P: planktic, P–B: planktonic-benthic, S: aerophytic, Ep: epiphytic); T: temperature, (temp: temperate water, eterm: eurythermic water, warm: warm water, cool: cool water); Reo: streaming and oxygenation, (st: standing water, str: stream, st-str: standing-streaming, aer: aerophile); D: saprobity, (es: eurysaprobe, sx: saproxen, sp: saprophile); Hal: salinity, (mh: mesohalobe, oh: oligohalobe, i: oligohalobious-indifferent, hl: oligohalobious-halophilous); pH: Acidity, (ind: indifferent, alf: alkaliphile, acf: acidophil, alb: alkalibiont); Geo: Geography, k: cosmopolit. **Note:** For saprobity, 'D' according to Watanabe *et al*. (1986).

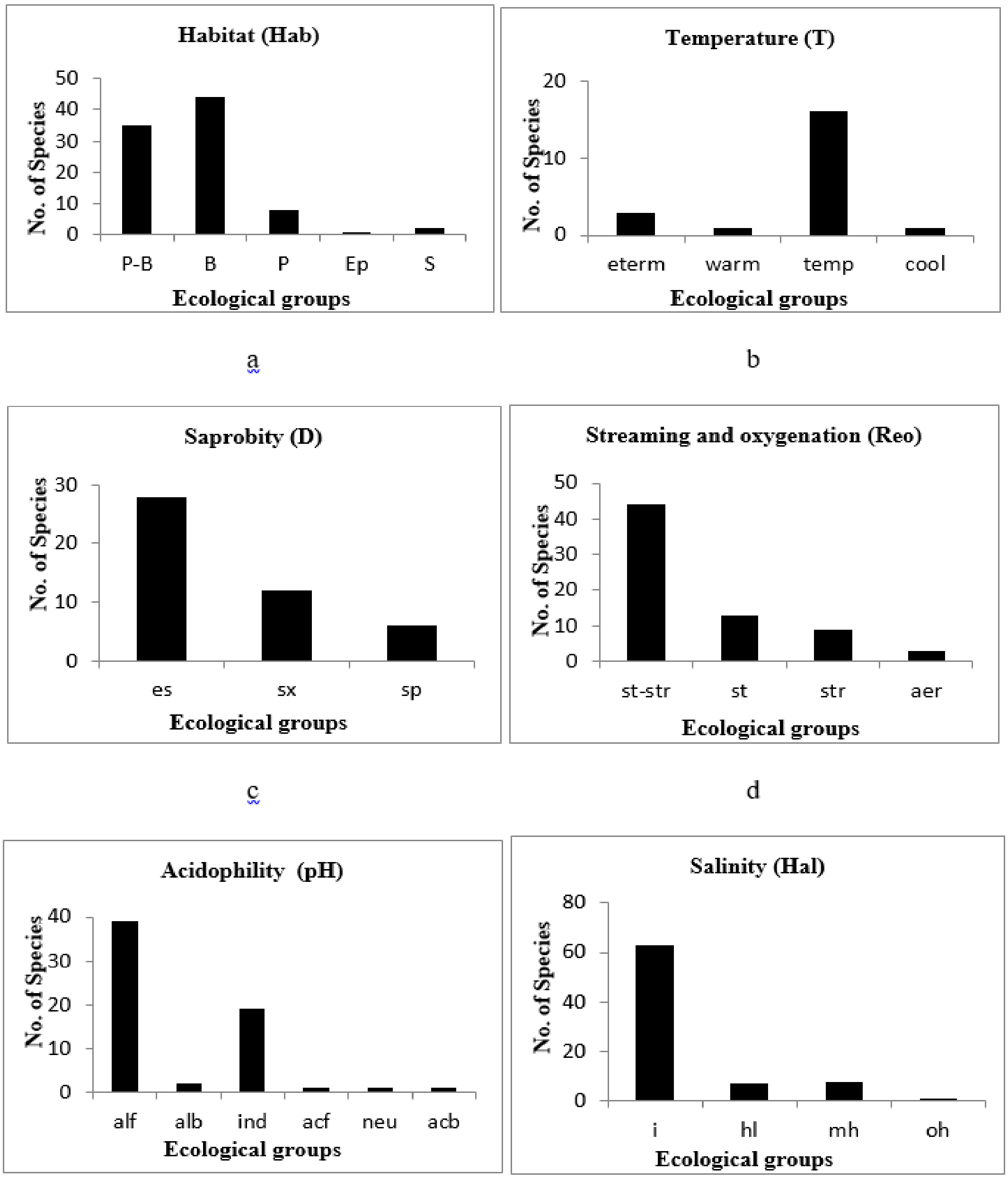

Figure 2. Ratios of the ecological groups according to the water quality parameters and habitats during the study period.

scores belonging to DO (=1), NH_4^+ (=2) and BOD (=3.75) indicated that the Melen River water had a good chemical status, while the value of suspended solids (=7.25) showed severely polluted water. Since the river bottom structure is composed of sand, silt and mud, the river environment is very sensitive to erosion and sediment transportation. In addition, agricultural inputs and anthropogenic impacts on the river bed have increased the amounts of suspended solids. Therefore, in the anthropogenically transformed river, diatoms will, in particular, indicate inferior water quality, compared to the indications derived from chemical parameters (Noga *et al*., 2016).

Conclusion

A total of 88 of the 148 taxa identified in the epiphytic and epilithic samples from 6 stations along the Melen River were determined as indicator taxa. Most of the indicator Bacillariophyta species preferred alkaline environments, while the other groups were indifferent. Ecological analysis showed that the algal community of Melen River preferred low salinity, as demonstrated by the prevalence of “oligohalobes-indifferent” groups. Most of the species (especially the diatoms) are common in waters with different hydrological conditions. They prefer oligo-to-eutrophic and β-mesosabrobic waters. Indicators of saprobity, according to Watanabe’s methods, showed a low to moderate level of organic pollution.

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