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STRUCTURE, SEASONAL DYNAMICS AND VERTICAL DISTRIBUTION OF DIATOMS IN LAKE DURGĂU NEAR TURDA (CLUJ COUNTY, ROMANIA)

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Abstract: Structure, seasonal dynamics and vertical distribution of diatoms in Lake Durgău near Turda (Cluj County, Romania). This paper is the first one dealing with the diatom communities of Lake Durgău, Turda, based on samples collected seasonally in 2005. There have been identified 84 diatom species occurring in both periphyton and plankton communities. Many of the detected species are halobionts or halophilous. Aspects related to the effect of salinity on species composition, seasonal dynamics and vertical distribution of diatoms are also discussed.

Keywords: diatom community structure, dynamics, vertical distribution, salinity, diversity, similarity

Introduction

Although diatoms form a group of the most significant aquatic photosynthetic organisms, one of the most important links in the life cycle of aquatic ecosystems, they have been relatively poorly documented in saline waters not only in Romania, but all over the world. This paper intends to provide further information to their knowledge based on some Romanian saline ecosystems. It also represents a part of a greater study regarding the diatom flora of nine lakes located in the surroundings of Turda, exhibiting various physical and chemical properties.

Lake Durgău is located in the „Sărată" Valley, North-West from the Turda town (Cluj County) (Fig. 1). The lake has a relatively long history, it dates back probably to Roman times, and it has been formed by the collapse of ancient salt mines. The lake was, and it is still used as bathing place with recreational purposes. The maximum depth is 4.5 meters, the chemical and physical parameters of water vary as shown in the next chapters.

Materials and Methods

The samples were collected seasonally in 2005, using standard sampling and processing methods. Integrated samples were collected from the periphyton for the analysis of fixed diatom assemblages, and plankton ones all over the surface and from the whole water body, to investigate the vertical composition and distribution of plankton diatoms. The investigations were carried out by using common laboratory techniques employing a Nfpk Zeiss Jena light microscope and standard taxonomical key books [1, 2, 3, 4].

Parallel with the sampling process, some chemical and physical parameters were measured, such as: salinity (mg l^{-1}), TDS (mg l^{-1}), conductivity (µS cm^{-1}), pH, dissolved oxygen (%, mg l^{-1}), air and water temperature (ºC). The changes of these parameters just below the water surface (where most periphytic community develops) were monitored through the whole year 2005.

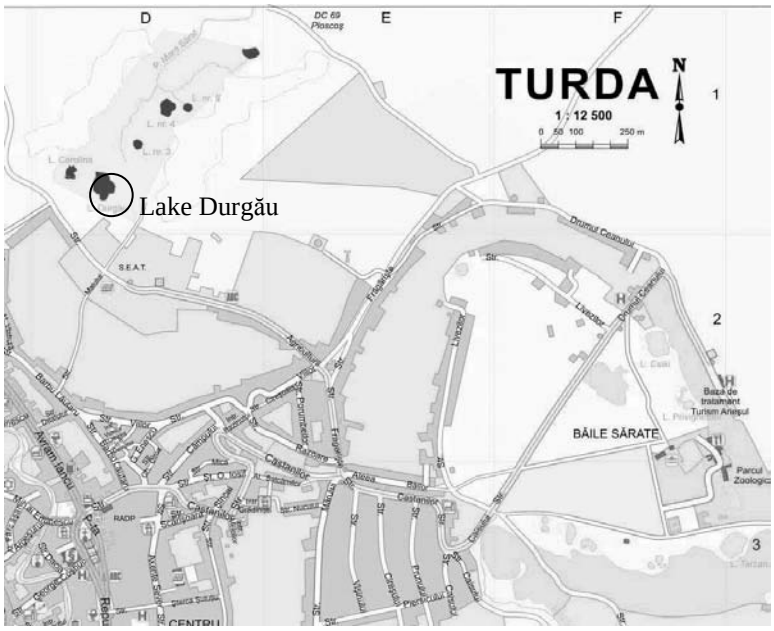

Fig. 1: Geographical location of Lake Durgău

Results and Discussions

The salinity -just below the water surface- (together with TDS and conductivity) varied during the year between 700 and 2000 mg l^{-1}, exhibiting slightly higher values in summer. The water was well oxygenated during the whole year (always over 10 mg l^{-1}), while the pH remained almost constantly around 8.0. On the other hand, there have been observed some interesting phenomena as regarding the vertical variations of the parameters. For example, the salinity, TDS and conductivity reached very high values at 3-4 meters depth (up to 39200 mg. l^{-1} and 62200 µS cm^{-1} respectively (Fig. 2). Another unexpected finding was that the value of pH dropped at the above mentioned depths to 6.59.

Another aspect that should be mentioned is that regarding the silting process of the lake. In 1910 and 1926 its maximum depth was 6 and 5.25 meters [5], while in 2005 it was only 4.5 meters deep.

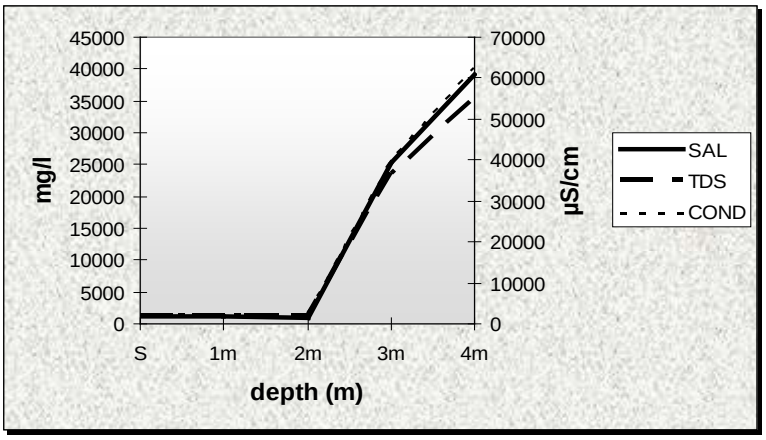

Fig. 2: Variation of salinity, TDS and conductivity

There have been identified 84 diatom species (Tab. 1.), belonging to 6 families (Thalassiosiraceae, Fragilariaceae, Achnanthaceae, Naviculaceae, Bacillariaceae and Surirellaceae) (Fig. 3), the families with the highest number of species being Naviculaceae (57.14%) and Bacillariaceae (25%). The analyses of periphytic and planktonic communities showed that most diatoms preferred and developed better on rather solid substrata. 56% of the species has been identified exclusively in this type of habitat, while only 8% were identified exclusively in the plankton. The rest of the species were seemingly indifferent, occurring in both habitat types.

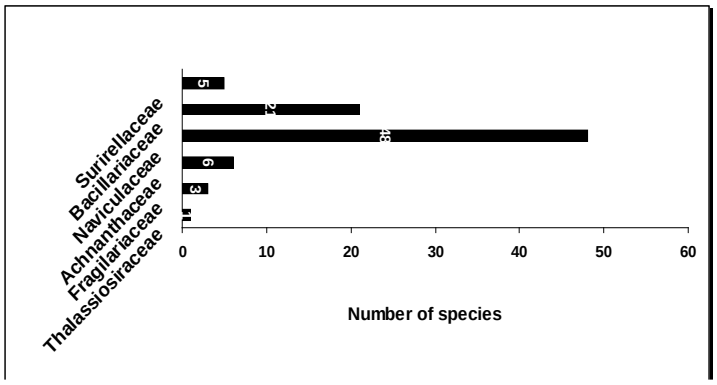

Fig. 3: Percentage distribution of diatom taxa

The seasonal dynamics was more obvious in the plankton community. Analyzing the vertical distribution of planktonic diatom communities in different seasons, it became evident that the surface layer almost always contained more species than the deeper ones. On the other hand, at 3-4 meters (probably due to increased salinity and reduced light conditions) there were only few or no species found. The number of species did not vary too much in the periphytic diatom communities, the lowest being detected in summer. The cluster analysis of communities developing in different seasons (based on the similarity index of Morisita) demonstrated the highest similarity (about 0.7) between the periphytic diatom communities developing in January and April, as well as between those occurring in July and October.

The diversity of diatom communities was relatively low in each season, usually a single species being dominant, namely *Achnanthes minutissima* Kützing. Diversity was slightly higher in autumn, the Shannon-Wiener index and the echitability exhibited 0.62, respectively 0.38.

Seemingly, the relatively high salinity markedly influenced the species composition of communities. About 49% of the identified diatoms are halophilous and halobionts, 21% of them frequently occur in salt waters too. The fact, that there are also present many freshwater species suggests that the salinity stress is not so pregnant to eliminate totally such forms.

Table 1: Qualitative structure of periphytic and planktonic diatoms from Lake Durgău

	SAMPLING SITES																			
	JAN		APR						JUL						OCT					
TAXA	**P**	**S**	**P**	**S**	**1m**	**2m**	**3m**	**4m**	**P**	**S**	**1m**	**2m**	**3m**	**4m**	**P**	**S**	**1m**	**2m**	**3m**	**4m**
CENTRALES																				
Coscinodiscineae																				
Thalassiosiraceae																				
Cyclotella comta (Ehrenberg) Kützing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
PENNALES																				
Araphidineae																				
Fragilariaceae																				
Fragilaria crotonensis Kitton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Fragilaria fasciculata (Agardh) Lange-Bertalot	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fragilaria pulchella (Ralfs ex Kützing) Lange-Bertalot	+	+	+	+	-	-	-	-	+	-	-	-	-	-	+	-	+	-	-	-
Raphidineae																				
Achnanthaceae																				

Achnanthes brevipes Agardh var. *intermedia* (Kützing) Cleve	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Achnanthes coarctata (Brébisson) Grunow	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Achnanthes holsatica Hustedt	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Achnanthes minutissima Kützing	+	+	+	+	+	+	-	-	+	+	+	+	+	-	+	+	+	+	+	+
Cocconeis placentula var. *lineata* (Ehrenberg) Van Heurk	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cocconeis placentula var. *euglypta* (Ehrenberg) Grunow	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Naviculaceae																				
Amphora coffeaeformis (Agardh) Kützing	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphora commutata Grunow	+	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Amphora ovalis (Kützing) Kützing	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphora pediculus (Kützing) Grunow	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anomoeoneis sphaerophora f. *sculpta* (Ehrenberg) Krammer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Caloneis amphisbaena (Bory) Cleve	+	+	+	+	+	+	-	-	+	-	-	-	-	-	+	-	-	+	-	-
Caloneis silicula (Ehrenberg) Cleve	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Cymbella microcephala Grunow	-	-	-	-	-	-	-	-	+	-	+	-	+	-	+	+	+	+	+	+
Cymbella pusilla Grunow	+	-	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-
Cymbella silesiaca Bleisch	+	-	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-
Didymosphaenia geminata (Lyngbye) M. Schmidt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Entomoneis alata (Ehrenberg) Ehrenberg	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-
Entomoneis paludosa var. *subsalina* Cleve	+	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-
Gomphonema clavatum Ehrenberg	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gomphonema minutum (C. Agardh) C. Agardh	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gomphonema olivaceum (Hornemann) Brébisson var. *olivaceum*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gomphonema parvulum (Kützing)	+	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Gomphonema truncatum Ehrenberg	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyrosigma acuminatum (Kützing) Rabenhorst	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-

Gyrosigma spencerii (Quekett) Griffith & Henfrey	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-
Mastogloia smithii Thwaites	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	+	-
Navicula cincta (Ehrenberg) Ralfs	+	+	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-
Navicula cryptocephala Kützing	+	-	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-
Navicula cryptotenella Lange-Bertalot	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Navicula digitoradiata (Gregory) Ralfs	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula eidrigiana Carter	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula gregaria Donkin	+	+	-	-	-	-	-	-	+	-	-	-	-	-	+	+	-	-	-	-
Navicula halophila (Grunow) Cleve	+	+	+	+	+	+	-	-	+	+	+	+	+	-	+	+	+	+	+	+
Navicula heimansii Van Dam & Kooyman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Navicula lanceolata (C. Agardh) Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Navicula laterostrata Hustedt	+	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Navicula margalithii Lange-Bertalot	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula normaloides Cholnoky	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula protracta (Grunow) Cleve	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula pseudoscutiformis Hustedt	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula pupula Kützing var. *pupula*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula pygmaea Kützing	-	-	+	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-
Navicula salinarum Grunow var. *salinarum*	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula spicula (Hickie) Cleve	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Navicula stankovicii Hustedt	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula subrhynchocephala Hustedt	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula tripunctata (O. F. Müller) Bory	+	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Navicula veneta Kützing	+	-	+	+	-	-	-	-	+	-	+	+	-	-	+	+	+	+	-	+
Navicula viridula (Kützing) Ehrenberg var. *viridula*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinnularia appendiculata (Agardh) Cleve	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	+	-	-	-
Pinnularia divergentissima (Grunow) Cleve	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-
Pleurosigma elongatum W. Smith	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Rhoicosphenia abbreviata (Agardh) Lange-Bertalot	+	+	+	+	-	-	-	-	+	-	-	-	-	-	+	+	-	-	-	-

Bacillariaceae																						
Bacillaria paradoxa Gmelin	+	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia aurariae Cholnoky	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia clausii Hantzsch	+	-	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-
Nitzschia communis Rabenhorst	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-
Nitzschia constricta (Kützing) Ralfs	+	+	+	+	+	-	-	-	+	-	-	+	-	-	+	+	+	+	-	-	-	-
Nitzschia elegantula Grunow	+	-	+	-	+	-	-	-	+	-	+	-	-	-	+	+	+	+	-	-	-	-
Nitzschia fonticola Grunow	+	-	+	-	-	-	-	-	+	-	+	+	-	-	+	-	-	-	-	-	-	-
Nitzschia frustulum (Kützing) Grunow var. *frustulum*	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia hungarica Grunow	+	-	+	+	-	-	-	-	+	-	-	-	-	-	+	+	+	-	-	-	-	-
Nitzschia inconspicua Grunow	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-
Nitzschia levidensis var. salinarum Grunow	+	-	+	-	-	-	-	-	+	-	-	-	-	-	+	+	-	+	-	-	-	-
Nitzschia lorenziana Grunow	+	-	+	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	-	-	-
Nitzschia nana Grunow	-	+	+	-	-	-	-	-	+	-	-	-	-	-	+	+	+	-	-	-	-	-
Nitzschia palea (Kützing) W. Smith	-	-	-	+	+	+	-	-	+	-	-	+	+	-	+	+	+	+	-	-	-	-
Nitzschia pellucida Grunow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-
Nitzschia pusilla Grunow	+	-	-	+	-	-	-	-	+	-	-	-	+	-	+	-	-	-	-	-	-	-
Nitzschia scalpelliformis Grunow	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia sigma (Kützing) W. Smith	+	-	+	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Nitzschia solita Hustedt	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitzschia tryblionella Hantzsch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Nitzschia tubicola Grunow	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Surirellaceae																						
Campylodiscus bicostatus W. Smith	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
Cymatopleura solea (Brébisson) W. Smith	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
Surirella angusta Kützing	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surirella brebissonii var. *kuetzingii* Krammer & Lange-Bertalot	+	-	+	+	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-
Surirella ovalis Brébisson	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-

Conclusions

Based on the samples collected in 2005, a relatively high number of diatom species were identified (84), belonging to 6 families. On the other hand, the low values of the Shannon-Wiener diversity index are due to the dominance (over 80% of total individuals in some samples) of *Achnanthes minutissima* Kützing. If one compares the species richness of periphytic and planktonic diatom communities, it is obvious that 56% of identified taxa were present only in the

periphyton, 8% only in plankton, while 36% in both types of habitats. The present findings also suggest that most of the planktonic diatoms have their "origin" in the periphytic communities, being possibly washed into the plankton. The salinity is an important factor that affects the species composition of diatom communities, many of the identified diatoms being halophilous and halobionts. Presumably the salinity stress is not so pregnant in the lake to eliminate all freshwater species.

The seasonal dynamics is more relevant in the plankton than in the periphyton; the vertical distribution of diatoms differs in each season, but there is a general preference of diatoms for the upper layer, being poorly represented in the deeper ones (3-4 meters).

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STRUCTURA, DINAMICA SEZONIERĂ ŞI DISTRIBUȚIA PE VERTICALĂ A DIATOMEELOR DIN LACUL DURGĂU - TURDA (JUD. CLUJ, ROMÂNIA)

(Rezumat)

Lacul studiat este localizat la NE de municipiul Turda, chiar la marginea oraşului. În ciuda faptului că lacul are o lungă istorie (s-a format probabil încă de pe vremea romanilor, în urma prăbuşirii unei ocne mai mari sau a două ocne mai mici) şi că de-a lungul timpului a fost intens folosit în scop recreativ şi balnear, până în prezent nu s-au realizat studii diatomologice. De altfel, trebuie menționat că flora de diatomee din ecosistemele acvatice sărate continentale a fost relativ puțin studiată până în prezent atât pe plan național cât şi mondial. În această lucrare sunt prezentate rezultatele cercetărilor efectuate în cele patru anotimpuri ale anului 2005. S-au identificat 84 specii aparținând la 6 familii, cele mai bine reprezentate fiind Naviculaceae şi Bacillariaceae. Cercetările au abordat, de asemenea, aspecte legate de structura, diversitatea, dinamica sezonieră şi distribuția pe verticală în masa apei a comunităților de diatomee.