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DIATOMS AND WATER QUALITY OF THE ZETEA LAKE AND SURROUNDING RIVER COURSES (HARGHITA COUNTY, ROMANIA)

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Abstract: The paper deals with a recent short term investigation of the diatom species inhabiting the Zetea Lake, an artificial dam lake in the Harghita County (Romania) and some major river courses in the immediate surroundings of the lake. In the light of the increasing pollution of waters everywhere, diatomological results were also used in this study to evaluate the present quality of water bodies herein dealt with.

The results are based on benthic samplings performed in the spring of 2015. The species number and the diversity of the diatom communities were somewhat higher than expected, with several species and varieties mentioned for the first time or only rarely earlier in the Romanian algological literature. The water quality seems satisfying for now, but already with signs of degradations in certain sites where human presence is evident.

Considering that the investigated area still harbors diatom species and varieties which have not yet been recorded in Romania, further investigations are required not only for its algal flora, but as well for long term monitoring of the water quality in the area.

Keywords: diatoms, biological diatom index (BDI), biomonitoring, pollution, water quality, Zetea Lake, Târnava Mare, Sâncel and Șicasău streams.

Introduction

It is well known that diatoms are worldwide used in water quality assessments, due to their exceptional indicator value and to the fact that is relatively easy to work with them [3, 7, 8, 15, 16].

In accordance with the European Water Framework Directive the number of studies regarding the diatoms and water quality of different Romanian lakes, rivers and streams increased significantly, especially in the last decade [9, 17, and 21]. This is the context and background of the present study, which aims to contribute to the growing diatomological database of the Romanian waters with the diatom species that inhabit the artificial dam lake on the Târnava Mare river near the locality of Zetea (Harghita County), and the major river courses in the immediate neighborhood of the lake, namely the courses of the Târnava Mare, upstream and downstream the lake, and the Șicasău and Sâncel streams, two smaller affluents of the Târnava Mare, which have their confluence with the river at the level of the lake.

The dam was gradually built between 1976 and 1992, actually on the upper course of the Târnava Mare in a mountainous area, eventually resulting in a lake with a surface of 14 *ha* and a volume of 44 km^3 water. The length of the lake is approximately 2.6 km, while its width varies

between 400–800 m. Besides the Târnava Mare River, the Șicasău and Sâncel streams are two of the major tributaries that also feed the lake, but the only outflow for the water of the Zetea Lake is the Târnava Mare River.

Ultimately, the study aimed to answer the following major questions or problems: **a.** which are the compositional and structural properties of the diatom communities inhabiting the investigated area? **b.** what kind of relationship can be revealed between the diatom communities and the environmental factors? **c.** what can be said about the present quality status and ecological integrity of the investigated water bodies, based on the species composition of the inhabiting diatom communities and the relative abundances of each present species?

Materials and Methods

The benthic diatom samples were collected in the spring of 2015, from a total of 8 sampling sites. Four of these were scattered along the littoral zone of the lake, two points were located on the Târnava Mare river (one upstream to the Zetea Lake and one downstream to the dam), and one sampling point on each of the two smaller tributaries, namely the Șicasău and the Sâncel streams, also upstream to the lake. The Zetea Lake and its surroundings with the locations of the sampling sites are shown in Fig. 1.

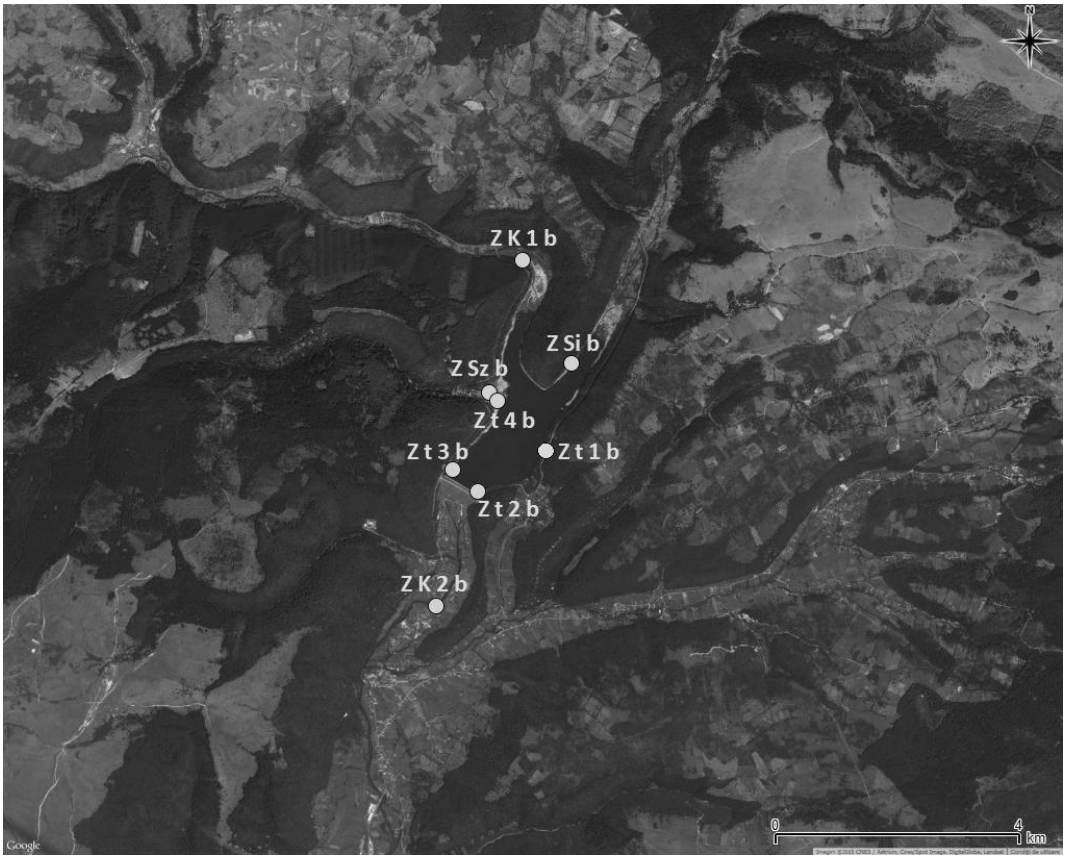


Fig. 1: The artificial dam lake on the Târnava Mare river, near Zetea with four sampling sites in the littoral area of the lake (Zt 1b, Zt 2b, Zt 3b, Zt 4b), two sites on the Târnava Mare upstream (ZK 1b) and downstream (ZK 2b) to the lake, and two sampling sites on the Șicasău (ZSi b) and Sâncel (ZSz b) tributaries.

The samples were collected with a brush from every available substrate [19] in the littoral zone of the lake and the river beds [2]. The samples collected from different substrates on each sampling site were mixed in order to obtain later an overall view in terms of the diatom communities inhabiting each sampling site, regardless of the substrate types [4]. The samples were also fixed on site with 70% ethanol, then treated in laboratory with 30% H_2O_2 and 1 N HCl solutions at 70-80 ºC temperature for a few hours [1], then repeatedly washed with distilled water, in order to clean the diatom frustules of any organic substances present in the samples [20]. Cleaned frustules were mounted in colophony and examined later at a Krüss MBL2100 light microscope with oil immersion lens, at a magnification of 1500X. Diatoms were identified at species, variety and form level, based on the available identification keys [10, 11, 12, 13, and 14]. Relative abundance of each species in each sample was determined for later statistical analysis. Some diatom frustules were photographed during this process, with a device attached to the microscope. Statistical analysis of the data was performed by means of PAST (Shannon diversity, Jaccard Similarity Index, Canonical Correspondence Analysis) and the IBD-NEW program for Biological Diatom Index [6].

Besides collecting benthic sample, *in situ* measurements were carried out in the spring of 2015 with a Consort C532 portable multimeter, in terms of some major physical and chemical properties of the water (temperature, pH and specific conductivity). The results of the measurements are considered to be orientative.

Results and Discussion

The results of the physical and chemical measurements are shown is Table. 1. The values of the water temperature are relatively low, but normal for spring periods in the area, varying between 4.8 ºC and 9.4 ºC with an average of 6.88 ºC, the somewhat higher value of 12 ºC at the Z t 3b (Zetea Lake) was not taken into consideration.

Table. 1: Values of water temperature, pH and specific conductivity measured in the spring of 2015 at the Zetea Lake and the major surrounding river courses

No.	Sampling site	Sample code	Temp. (^{0}C)	pH	Spec. conductivity ($\mu S \cdot cm^{-1}$)
1	Zetea Lake	**Z t 1 b**	5.7	6.17	50.6
2	Zetea Lake	**Z t 2 b**	7.3	6.14	51.5
3	Zetea Lake	**Z t 3 b**	12	7.01	58.4
4	Zetea Lake	**Z t 4 b**	6.2	4.19	47.8
5	Târnava Mare river, upstream	**Z K 1 b**	4.8	6.54	44.4
6	Târnava Mare river, downstream	**Z K 2 b**	6.1	6.84	55.6
7	Şicasău, upstream	**Z Si b**	9.4	6.44	51.8
8	Sâncel, upstream	**Z Sz b**	8.7	6.57	52.7

In most of the sampling sites, the pH of the water was somewhat below 7.00, with two exceptions: at the Z t 3b sampling site the pH reaches 7.01, and a value of 4.19 at the Z t 4b sampling site in the littoral zone of the Zetea Lake (Fig. 2.). With the exception of the last value, which indicates acidic environment, the pH values fall into a normal range for natural surface waters. The Zt 4 b is that site of the littoral zone of the lake which is the mostly influenced by humans (ex. weekend houses). There is a possibility that increased human activities at this site

are related to the lower pH of the water, and the acidification on this site. Further measurements are definitely needed in this matter.

The values of the specific conductivity of the water are low, varying between 44.4 and 58.4 $\mu S \cdot cm^{-1,}$ with an average of 51.6$\mu S \cdot cm^{-1}$, indicating a small quantity of dissolved inorganic material, or zero salinity conditions.

Based on the samples collected in the spring of 2015, a total number of 189 diatom species, varieties and forms were identified inhabiting the littoral zone of the Zetea Lake and the immediate nearby courses of the Târnava Mare river (upstream and downstream to the barrage that generated the lake on the river) and the two smaller affluent tributaries (the Șicasău and Sâncel streams).

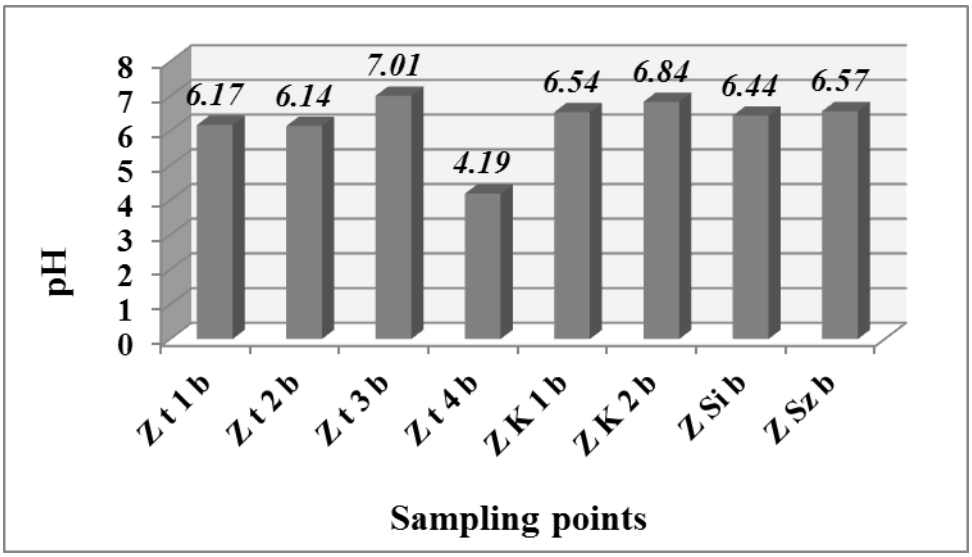


Fig. 2. The pH values of the water on different sampling sites

From the total number of diatom species and varieties (Table 2.) can be concluded that a larger number of diatom species constitutes the communities [18] of the lake (82.75 in average) than those inhabiting the river and stream courses (69.5 species and varieties in average). There is evident a somewhat increased diversity of the lake communities (ranging between 49 and 108 taxa) when compared with those of the river and streams (only 62 to 80 taxa) (Fig. 3.). This observation applies to the species diversity of the communities too, which seems to be determined mostly and significantly by the number of the species and varieties, rather than the equitability. The Shannon Diversity Index exhibits rather high values for each sample (community), with a maximum of 4.288 at the Z t 3 b sampling site, probably related to higher temperature. The higher variance could also be related to the human – possibly polluting – activities in one of the sites in the littoral zone, in which case pollution- and organic tolerant species may occur and increase the number of the species inhabiting the littoral zone of the Zetea Lake.

The species diversity in the Târnava Mare River downstream the Zetea Lake decreases, when compared to the communities inhabiting the upstream course of the same river (in average higher). However, there are plenty of factors that might explain such observation, for example differences between flow properties of the water, availability and properties of substrates for

benthic organisms etc. The sample collected from the Șicasău stream presented the lowest species diversity (Fig. 4.).

Table 2: The number of constituent diatom species (and varieties) of each sample with diversity indices (Shannon Index and equitability)

No.	Sample code	No. of species	Shannon-Index (H)	Equitability (J)
1	Z t 1 b	107	4.253	0.9102
2	Z t 2 b	49	3.55	0.9121
3	Z t 3 b	108	4.288	0.9158
4	Z t 4 b	67	3.351	0.797
5	Z K 1 b	80	3.614	0.8247
6	Z K 2 b	63	3.089	0.7456
7	Z Si b	62	2.888	0.6998
8	Z Sz b	73	3.513	0.8448

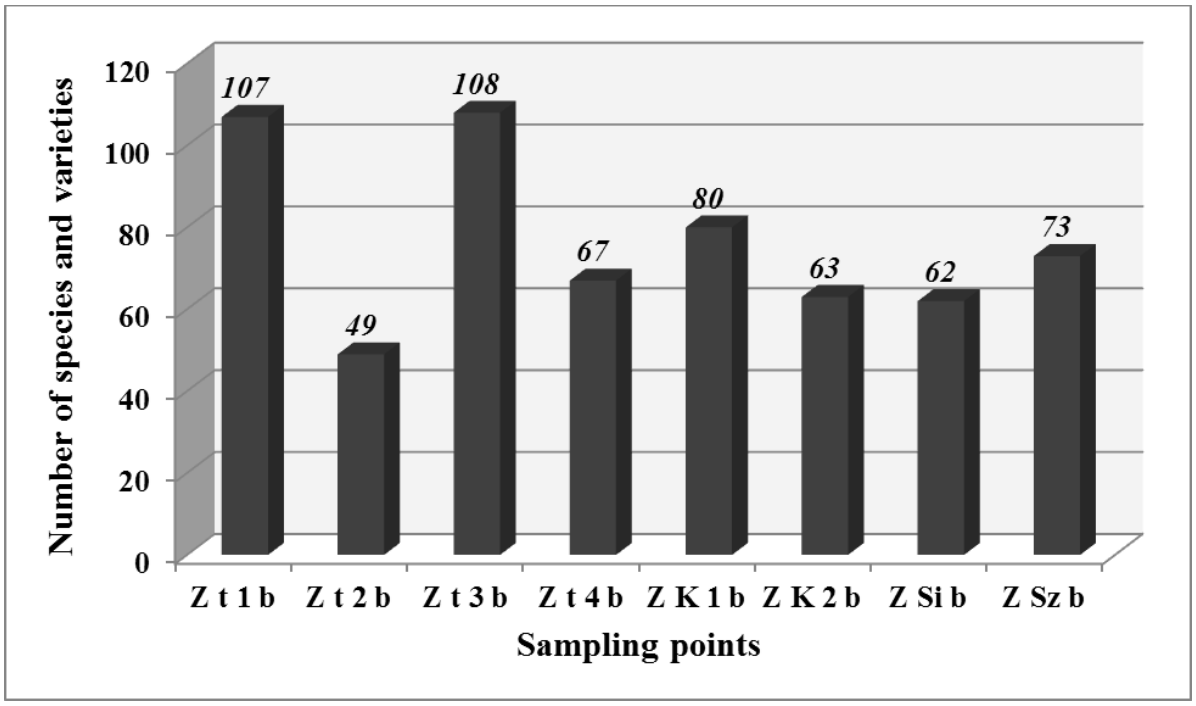


Fig. 3: Total number of diatom species and varieties per sample on the different sampling sites

Regarding the composition of the studied diatom communities, several species and varieties appeared frequently among the most abundant (dominant and subdominant) diatoms of almost all samples (communities). Such frequently and abundantly present species in the investigated area were:

- Both in the lake (Târnava Mare River) and tributaries are present: *Achnanthes minutissima, Aulacoseira crassipunctata, Fragilaria arcus* and *Navicula lanceolata*.

- Particularly occurring in the Zetea Lake and the Târnava Mare River: *Achnanthes catenata, Aulacoseira distans, Cymbella compacta, C. minuta, Fragilaria bicapitata, Nitzschia frustulum, N. dissipata* and *Navicula cryptocephala*.
- Occur only in the Șicasău and Sâncel streams: *Fragilaria capucina* var. *vauchaeriae* and *Meridion circulare.*

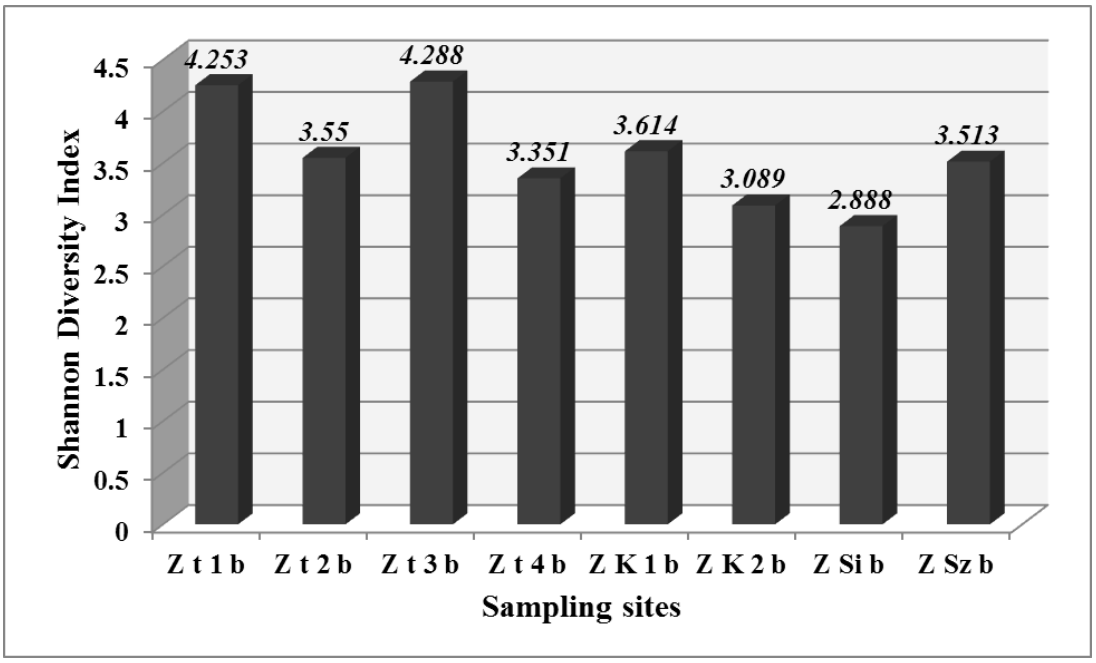


Fig. 4: The species diversity of the different benthic diatom communities based on the values of the Shannon Diversity Index

The degrees of floristic similarity between samples representing diatom communities have been calculated based on the Jaccard Similarity Index (Fig. 5.). On the diagram two major sample groups can clearly be distinguished: the communities inhabiting the dam lake forming a condensed group, separated clearly from those inhabiting the river or stream courses. This emphasizes the standing water character of the lake compared to the flowing waters of the river and tributaries. From the diagram one may also deduce a visible change in the species composition and structure of the diatom communities inhabiting the Târnava Mare River upstream the dam lake, in comparison with the downstream communities. Furthermore, there was a relatively high degree of similarity between the diatom communities inhabiting the two smaller affluents (the Șicasău and the Sâncel), compared to the main river and the Zetea Lake.

Canonical Correspondence Analysis was performed in attemp to stress out the existing relationship between the composition and structure of the diatom communities and the major abiotic factors of their aquatic environment, as well as to emphasize those factors which possibly determine the composition of the diatom communities. Diagram A in Fig. 6 exhibits that the samples collected from the littoral zone of the lake form a relatively closely positioned group (similarly to the cluster analysis based on the floristic similarity), along the temperature and specific conductivity vectors. The communities inhabiting the Târnava Mare River upstream and

downstream to the dam lake seem to be the least influenced by the investigated abiotic factors. The samples from the Șicasău stream show a stronger affinity towards the pH vector.

As shown in the diagram B in Fig. 6., in which dots represent the single species and varieties of the diatom communities in each sampling site, the vast majority of the species prefer the average values of all three environmental factors (they are located around the origin of the vectors), but there are also present species – in a smaller number – which prefer higher or lower values of the water temperature, pH and specific conductivity, in this particular case representing the "mildly extremophile" part of the inhabiting diatom communities.

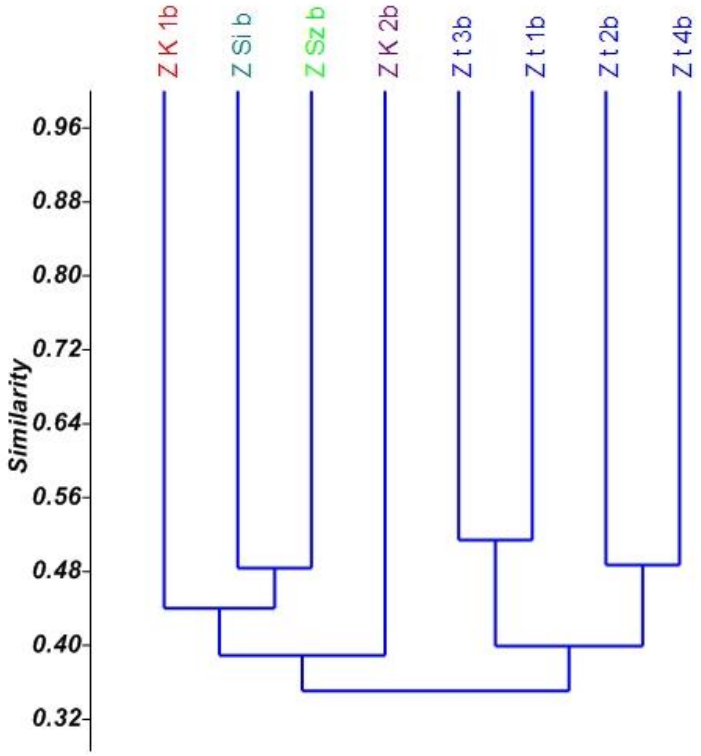


Fig. 5: Degrees of similarity between the different samples representing the diatom communities from the established sampling sites, based on the Jaccard Similarity Index

Special merit of the study is that among the 189 identified diatom taxa (species, varieties and forms) there are 4 species which have not yet been recorded for the Romanian algal flora [5]. There were also present in the collected samples other 40 diatom species and varieties rarely or even very rarely mentioned (a few times, in some cases only once) in the Romanian algological literature. The species mentioned for the first time or rarely mentioned before are listed below. They are also presented in the light micrographs (Appendix 1) together with some of the common species.

Diatom species which have not yet been recorded for the Romanian algal flora:

1. *Achnanthes catenata* Bily et Marvan (Zetea Lake, Târnava Mare river downstream)
2. *Navicula muticopsis* Van Heurck (Zetea Lake)
3. *Pinnularia* cf. *polyoncha* (Brébisson) W. Smith (Zetea Lake)
4. *Pinnularia cuneola* Reichardt (Zetea Lake)

Diatom species and varieties rarely mentioned before in the Romanian algological literature:

1. *Achnanthes laevis* Østrup
2. *Achnanthes laterostrata* Hustedt
3. *Achnanthes scotica* Lange-Bertalot
4. *Aulacoseira crassipunctata* Krammer
5. *Cocconeis placentula* var. *pseudolineata* Geitler
6. *Eunotia implicata* Nörpel, Lange-Bertalot et al.
7. *Fragilaria capucina* var. *perminuta*(Grunow) Lange-Bertalot
8. *Fragilaria montana* (Krasske) Lange-Bertalot
9. *Frustulia amosseana* Lange-Bertalot
10. *Gomphonema affine* Kützing
11. *Gomphonema parvulum* var. *parvulius* Lange-Bertalot et Reichardt
12. *Gomphonema pumilum* (Grunow) Reichardt et Lange-Bertalot
13. *Navicula angusta* Grunow
14. *Navicula elginensis* var. *cuneata* (M. Møller ex Foged) Lange-Bertalot
15. *Navicula exilis* Kützing
16. *Navicula gallica* (W. Smith) Lagerstedt
17. *Navicula gibbula* (Brébisson) W. Smith
18. *Navicula hambergii* Hustedt
19. *Navicula stroemii* Hustedt
20. *Navicula suecorum* var. *dismutica* (Hustedt) Lange-Bertalot
21. *Neidium affine* var. *longiceps* (W. Gregory) Cleve
22. *Neidium bisulcatum* var. *subampliatum* Krammer
23. *Nitzschia dissipata* var. *media* (Hantzsch) Grunow
24. *Nitzschia palea* var. *debilis* (Kützing) Grunow
25. *Nitzschia pumila* Hustedt
26. *Pinnularia acidophila* Hofmann et Krammer
27. *Pinnularia castraregina* Krammer
28. *Pinnularia grunowii* Krammer
29. *Pinnularia marchica* Ilka Schönfelder
30. *Pinnularia obscura* Krasske
31. *Pinnularia obscuriformis* Krammer
32. *Pinnularia schoenfelderi* Krammer
33. *Pinnularia sinistra* Krammer
34. *Pinnularia subgibba* Krammer
35. *Pinnularia subrupestris* Krammer
36. *Pinnularia viridiformis* Krammer
37. *Stauroneis anceps* f. *gracilis* (Ehrenberg) Cleve
38. *Stauroneis kriegeri* R.M. Patrick
39. *Stauroneis obtusa* Lagerstedt
40. *Stauroneis thermicola* (J.B. Petersen) Lund

As a part of the study, the water quality was estimated on each sampling site by computing the Biological Diatom Index (BDI), an index based on the species composition of the communities, the relative abundances and indicator value of each species and variety. The results (Fig. 7) indicate a generally good water quality in the studied area in spring of 2015. However, three sampling sites should be considered separately: based on the BDI of water in the Șicasău stream seemed to be excellent in the investigated period, while the water quality of the Zt 2 b and especially the Zt 4 b show the signs of decline. As mentioned before, at the Zt 4 b sampling point there is an increased human factor present, most probably being (one of) the reason(s) behind the deterioration of the water quality towards a sub-critical, not acceptable, mediocre state.

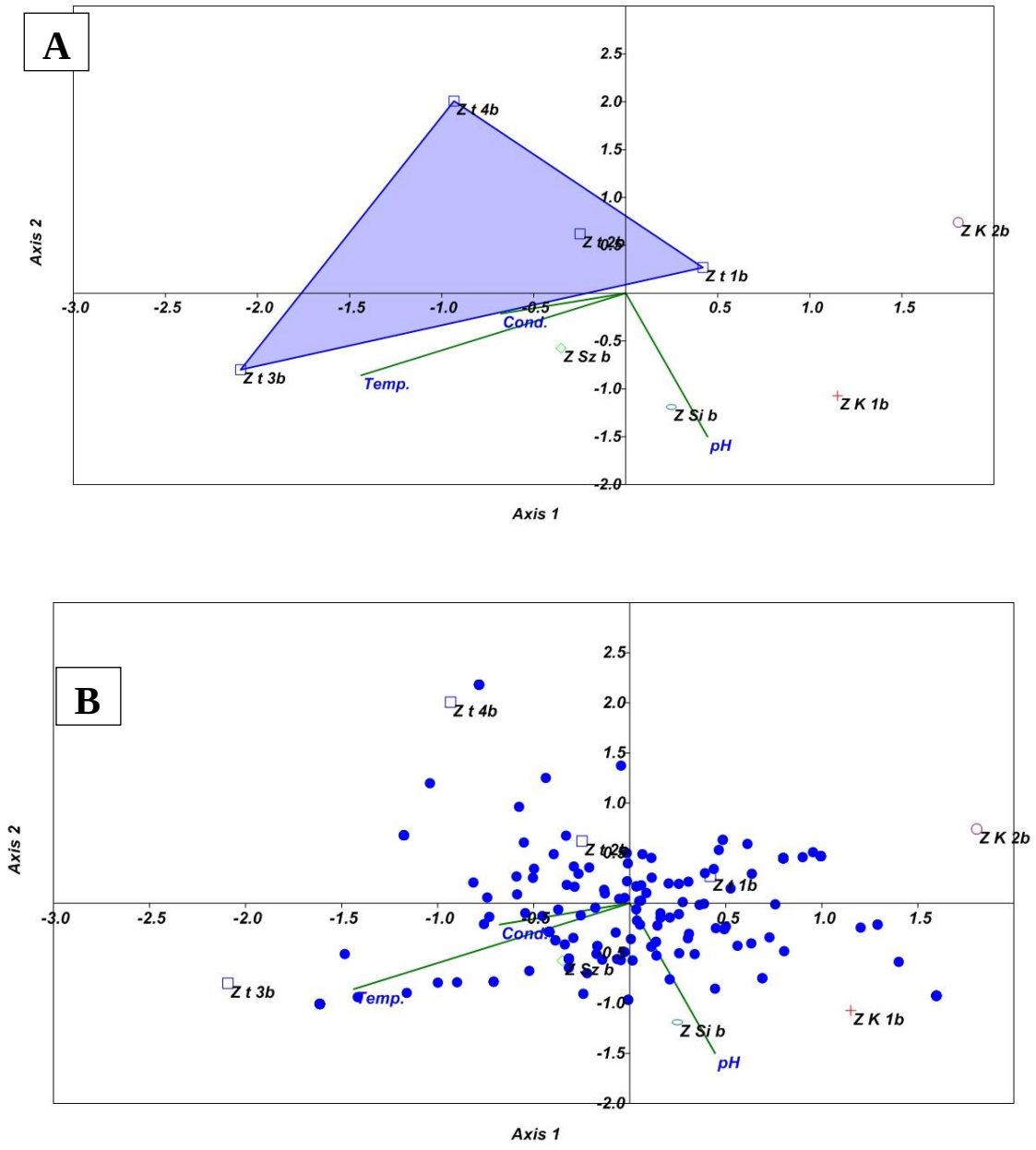


Fig. 6: Relations between the species composition of the diatom communities and some environmental factors (water temperature, pH and specific conductivity) (A) and the distribution of the species (represented by dots) as determined by the above factors (B), based on Canonical Correspondence Analysis (CCA)

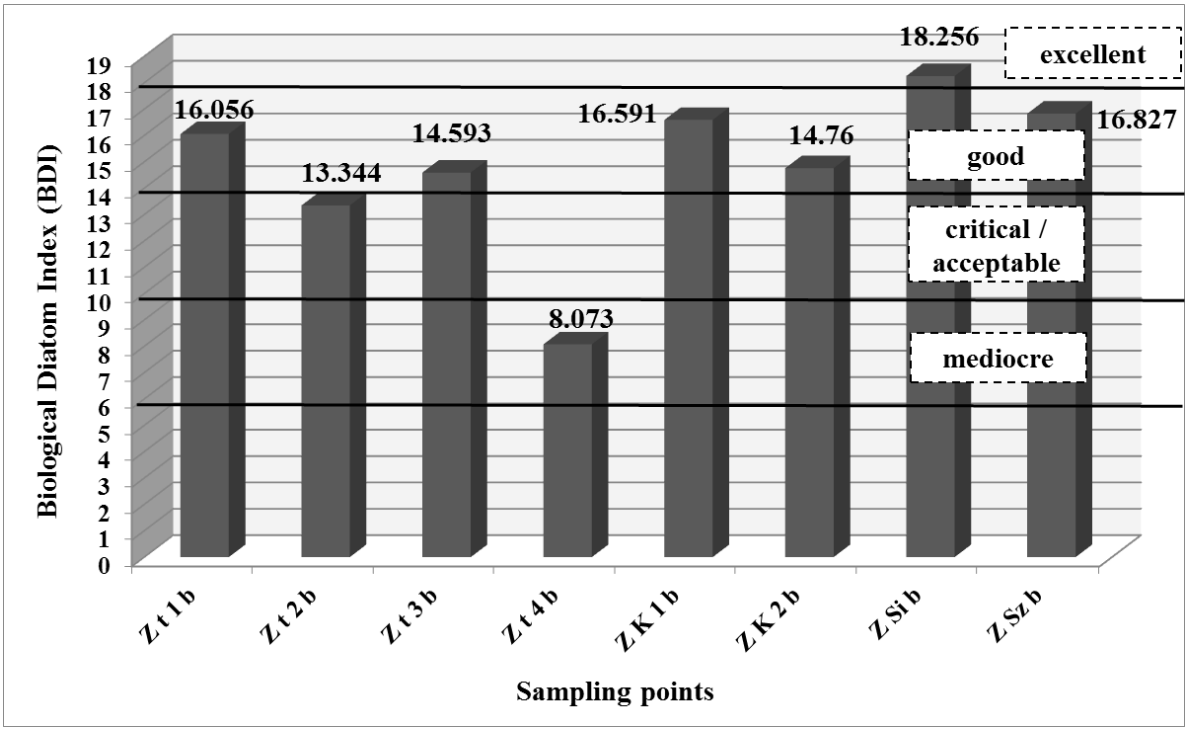


Fig. 7: The water quality of the Zetea Lake and surrounding river courses based on the values of the Biological Diatom Index (BDI)

Conclusions

- The water of the Zetea Lake, the Târnava Mare river and the tributaries Șicasău and Sâncel (with 8 sampling sites) exhibited general temperature and pH values normal for the area and season chosen for study, with low amount of dissolved inorganic substances and good water quality at most sampling sites (based on BDI). However, one site at the littoral zone of the Zetea dam lake, more intensely inhabited by human population, shows the signs of acidification and deterioration of water quality.
- The diatom communities which inhabit the littoral zone of the lake consist of a larger number of species and varieties with higher variance, comparatively to the communities inhabiting the river and stream courses, where the communities seem to be somewhat poorer in species, but more stable in composition. The floristic similarity between the communities indicates the same delimitation between lake and river courses, and stresses the compositional and structural difference between the diatom communities inhabiting the Târnava Mare River upstream and downstream the dam lake.
- The abiotic environmental factors dealt with seem to strongly influence the composition and structure of the diatom communities. The vast majority of the species prefer average environmental conditions, but there are present in less number somewhat more "extremophile" species too.
- Among the 189 diatom taxa (species, varieties and forms) identified in the collected samples, there are 4 new records for the Romanian algal flora and further 40 rarely mentioned species and varieties. These results demonstrate that the upper mountain course of the Târnava Mare River with the dam lake at Zetea and the smaller tributaries

can still be considered algal biodiversity hotspots, worth for further attention, monitoring and conservation.

REFERENCES

1. Ács, É., Kiss, K.T., (eds.), 2004, *Algológiai praktikum*, Ed. ELTE Eötvös, Budapest.
2. Angelier, E., 2003, *Ecology of Streams and Rivers*, Science Publishers, Inc., Enfield, New Hampshire, USA.
3. Bere, T., Tundisi, J.G., 2010, Biological monitoring of lotic ecosystems: the role of diatoms, *Brazilian Journal of Biology*, **70**(3): 493-502.
4. Biggs, B.J.F., Kilroy, C., 2000, *Stream Periphyton Monitoring Manual*, NIWA, Christchurch.
5. Cărăuș, I., 2010, Algae of Romania – A distributional checklist of actual algae, *Studii și Cercetări, Biologie*, Universitatea Bacău, **7**: 1-788, version 2.2.
6. Coste, M., Boutry, S., Tison-Rosebery, J., Delmas, F., 2009, Improvements of the Biological Diatom Index (BDI): Description and efficiency of the new version (BDI-2006), *Ecological Indicators*, **9**: 621-650.
7. Dixit, S.S., Smol, J.P., Charles, D.F., 1992, Diatoms: powerful indicators of environmental change, *Environmental Science Technology*, **26**(1): 23-33.
8. Giller, P.S., Malmqvist, B., 1998, *The Biology of Streams and Rivers*, Oxford University Press, Oxford.
9. Kallis, G., Butler, D., 2001, The EU water framework directive: measures and implications, *Water Policy*,**3**: 125-142.
10. Krammer, K., 2000, The genus Pinnularia. In: Lange-Bertalot, H., (ed.), *Diatoms of Europe. Diatoms of the European Inland Waters and Comparable Habitats*, Volume 1, A.R.G. Gantner Verlag Kommanditgesellschaft, Ruggell.
11. Krammer, K., 2002, Cymbella. In: Lange-Bertalot, H., (ed.), *Diatoms of Europe. Diatoms of the European Inland Waters and Comparable Habitats*, Volume 3, A.R.G. Gantner Verlag Kommanditgesellschaft, Ruggell.
12. Krammer, K., 2003, Cymbopleura, Delicata, Navicymbula, Gomphocymbellopsis, Afrocymbella. In: Lange-Bertalot, H., (ed.), *Diatoms of Europe. Diatoms of the European Inland Waters and Comparable Habitats*, Volume 4, A.R.G. Gantner Verlag Kommanditgesellschaft, Ruggell.
13. Krammer, K., Lange-Bertalot, H., 1986, 1988, 1991, 2000, Bacillariophyceae. In: Ettl, H., Gerloff, J., Heyning, H., Mollenhauer, D., (eds.), *Süsswasserflora von Mitteleuropa*, vol. 2/1-5, G. Fisher, Stuttgart.
14. Lange-Bertalot, H., 2001, Navicula sensu stricto. 10 Genera Separated from Navicula sensu lato. Frustulia. In: Lange-Bertalot, H., (ed.), *Diatoms of Europe. Diatoms of the European Inland Waters and Comparable Habitats*, Volume 2, A.R.G. Gantner Verlag Kommanditgesellschaft, Ruggell.
15. Li, L., Zheng, B., Liu, L., 2010, Biomonitoring and Bioindicators Used for River Ecosystems: Definitions, Approaches and Trends, *Procedia Environmental Science*, **2**: 1510-1524.
16. Lowe, R.L., Pan, Y., 1996, Benthic algal communities as biological monitors. In Stevenson, R.J., Bothwell, M.L., Lowe, R.L., (eds.), *Algal Ecology, Freshwater Benthic Ecosystems*, Academic Press, San Diego: 705-739.
17. McCormick, P.V., Cairns, J., 1997, Algal indicators of aquatic ecosystem condition and change. In: Wang, W., Gorsuch, J., (eds.), *Plants for environmental studies*, Lewis Publishers, Boca Raton.
18. Podani, J., 1992, Biological indication at the community and ecosystem levels. In: Kovács M., (ed.), *Biological indicators in environmental protection*, Akadémiai Kiadó, Budapest.
19. Smucker, N.J., Vis, M.L., 2010, Using diatoms to assess human impacts on streams benefits from multiple-habitat sampling, *Hydrobiologia*, **654**: 93-109.

20. Stevenson, J.R., Bahls, L.L., 1999, Periphyton protocols. In: Barbour, M.T., Gerritsen, J., Snyder, B.D., Stribling, J.B., (eds.), *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrate and Fish*, Second Edition, U.S. Environmental Protection Agency, Office of Water, Washington D.C.
21. Wetzel, R., (ed.), 2001, *Limnology: Lake and river ecosystems*, Academic Press, San Diego.

DIATOMEELE ȘI CALITATEA APEI LACULUI ZETEA ȘI A CURSURILOR DE RÂURI ÎN ÎMPREJURIMILE ACESTUIA (JUD. HARGHITA, ROMÂNIA)

(Rezumat)

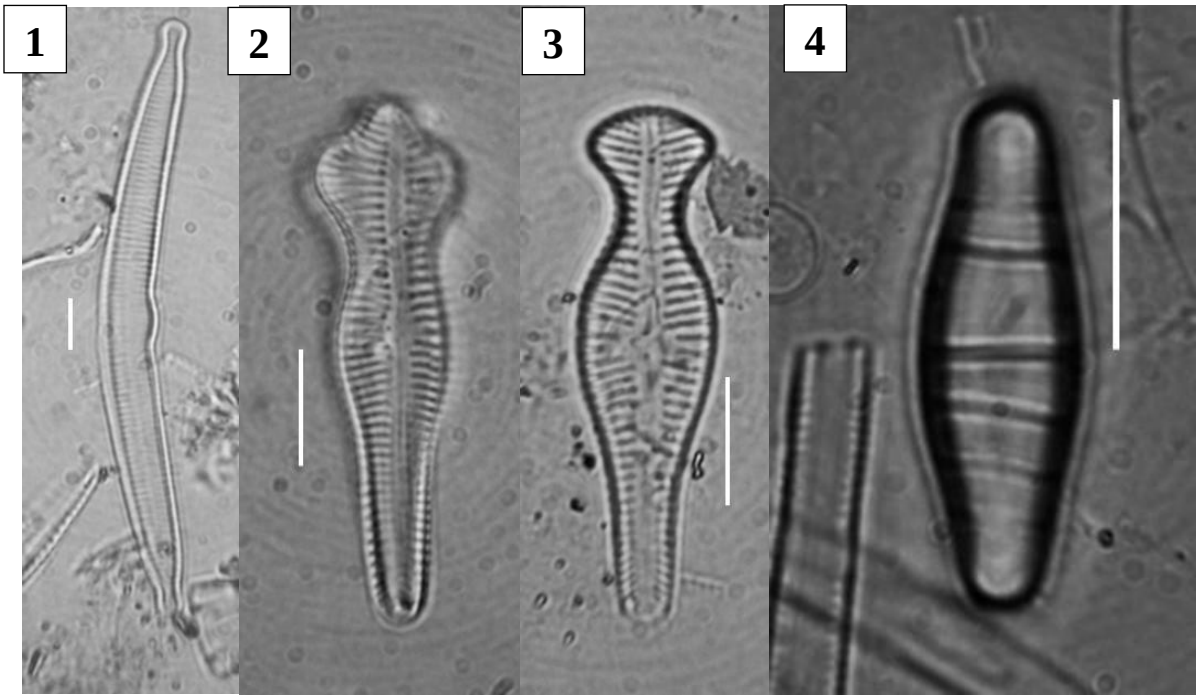
Lucrarea de față, bazându-se pe faptul că diatomeele în general sunt buni indicatori biotici ai ecosistemelor acvatice, abordează calitatea apei pe cursul superior al râului Târnava Mare în zona lacului de baraj de la Zetea, precum și pe doi afluenți (pâraiele Șicasău și Sâncel) prin prisma compoziției specifice și a structurii comunităților de diatomee bentonice din aceste ape.

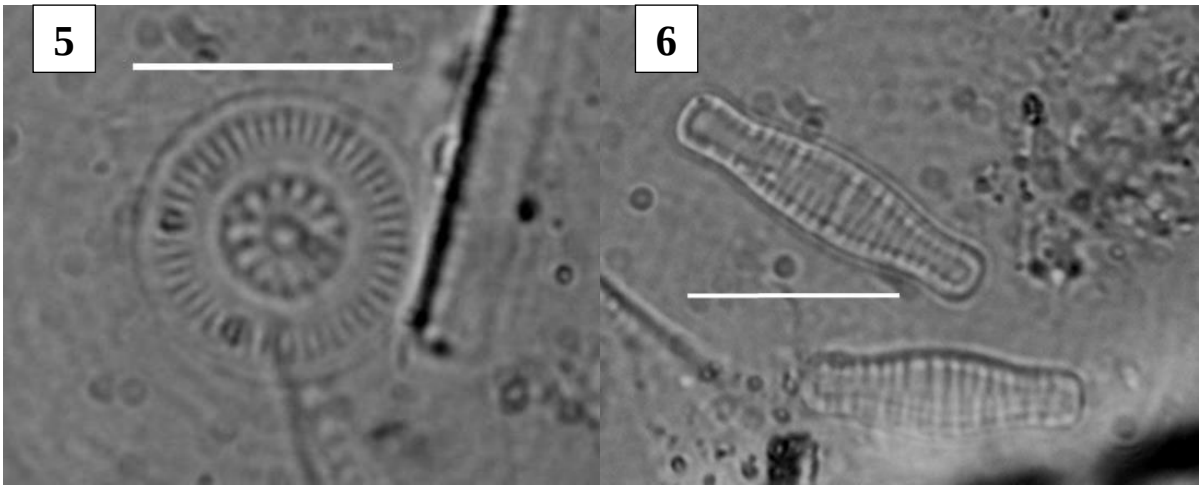
Probele bentonice au fost colectate în primăvara anului 2015, din 8 puncte de prelevare (4 în zona litorală a lacului artificial, 2 pe cursul Târnavei în amonte și în aval de lac, și 2 pe cursul pâraielor sus amintite, în imediata vecinătate a lacului de baraj). Rezultatele indică prezența unor comunități de diatomee relativ bogate în specii, mai ales în zona litorală a lacului de la Zetea, unde și diversitatea este mai mare, în contrast cu comunitățile bentonice din apele curgătoare studiate, ceva mai sărace în specii, dar aparent mai stabile. În stațiunea cea mai populată de oameni de pe litoralul lacului calitatea apei prezintă semne clare de deteriorare. Pe baza rezultatelor se conturează o relație strânsă între factorii abiotici ai mediului și comunitățile de diatomee, majoritatea speciilor preferând valori medii ai acestora, în timp ce sunt prezente – în număr mai redus – și specii cu preferințe oarecum mai ‘extreme”.

Printre cele 189 de specii, varietăți și forme de diatomee identificate în zona studiată, se găsesc 4 specii semnalate pentru prima dată din apele României, precum și alte 40 de specii și varietăți, rar semnalate până în prezent în țară. Aceste observații sugerează că, pe cursul superior al râului Târnava Mare, zona lacului de baraj de la Zetea, dar și afluenții mai mici ai Târnavei încă pot fi considerate zone importante pentru biodiversitatea algală, zone care prin urmare merită ținute în atenție, studiate și monitorizate în continuare în vederea unei eventuale conservări.

Appendix 1.

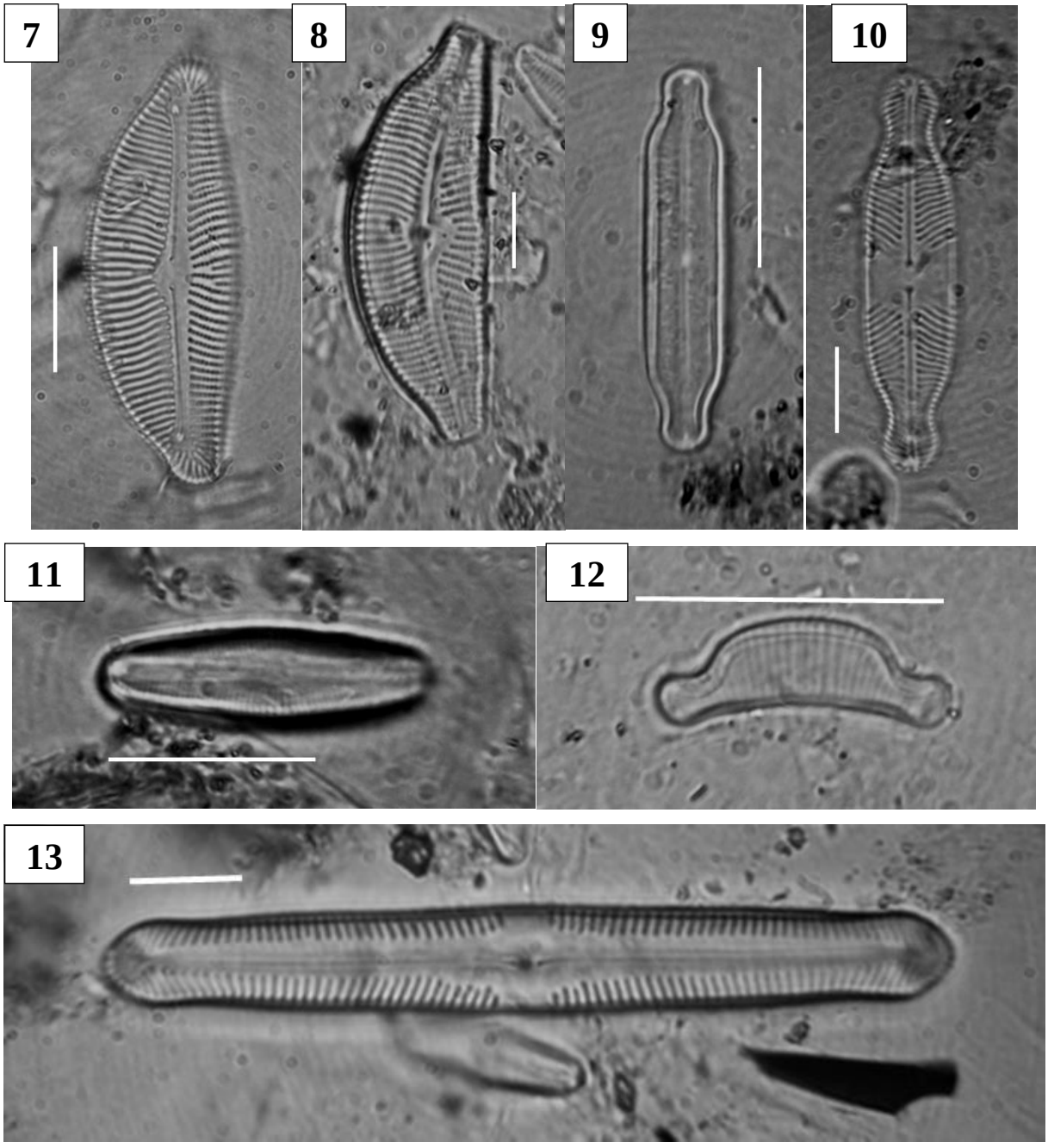
The frustules of some of the characteristic diatom species and varieties which inhabit the Zetea Lake and the surrounding river courses (Târnava Mare, Şicasău, Sâncel) (Harghita County, Romania). (*The photographs are original, made by the authors at light microscope. The white bar represents 10 µm*).





1 – *Fragilaria arcus*, **2** – *Gomphonema acuminatum*, **3** – *G. truncatum*, **4** – *Diatoma hiemale*, **5** – *Cyclotella pseudostelligera*, **6** – *Fragilaria bicapitata*

Appendix 1. (continued)



7 – *Cymbella prostrata*, **8** – *C. tumida*, **9** – *Neidium affine* var. *longiceps*, **10** – *Pinnularia lundii*, **11** – *Navicula gibbula*, **12** – *Eunotia septentrionalis*, **13** – *Pinnularia subgibba*

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