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Changes in The Aquatic Communities in the Rhodopes Mountain Landslide Lakes (South Bulgaria) for the Last 40 Years. I. Taxonomic Composition of Macrozoobenthos, Zooplankton and Fish Communities

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Abstract: The biodiversity of aquatic communities (macrozoobenthos, zooplankton and fish) in 5 of Smolyanski and 2 of Chairski landslide lakes was studied in spring and summer of 2010. A total of 19 taxa of different taxonomic level of macrozoobenthos and zooplankton were reported for the first time in the studied lakes. The enriched list included 4 new planktonic species (of Rotifera type) and 15 new macrozoobenthic taxa (4 species of Oligochaeta, 2 species of Bivalvia, one genus of Ephemeroptera, one species of Plecoptera, 4 species, 1 genera and 2 families of the Trichoptera groups). Five fish species were registered belonging to two families in the composition of the ichthyofauna of the studied lakes. The similarities in the species composition of the macrozoobenthos and zooplankton among the lakes and in comparison with previous investigations were assessed. The statistically significant differences found for the macrozoobenthos composition in comparison with the published in 1975 revealed two completely different communities. Moreover, this applied also to the zooplankton community which fundamentally differed from that found in 1975. The large number of taxa reported for the first time was probably due to the long period of time since the last studies (more than 40 years) and the changes in the ecological conditions in the lakes. A more refined examination of the ecosystem functioning could provide more comprehensive data about the processes in these lakes of high conservation value.

Key words: Smolyanski lakes, Chairski lakes, zoobenthos, zooplankton, fish

Introduction

This study is a part of a broader preliminary research on the ecosystems of the landslide lakes of the two bigest groups in the Rodope Mountain – Smolyanski and Chairski lakes. Herein the species composition of the three aquatic communities is represented only. The environmental factors and their functional linkage with the trophic structure of zoocenoses could be found in the second part of the study. The studied lakes belong to the type L3: Mountain lakes in the ecoregion 7 according to typology accepted in the process of classification of surface water bodies (system B), developed in accordance with the WFD. All of them are shallow lakes. There are diferences in the level of eutrophication advance and the varying density of submerged vegetation among the lakes, wich will take place in the second part of the study. All of the lakes are exposed to anthropogenic pressure, driving the diferent manifestations of impact on the aquatic communities, except Matno Lake, which could be regarded as a lake with referent conditions. Keranov gyol lake is transformed into a reservoir. Bistro and Trevisto lake are often dryig in summer, due to interruption of inflow. In Smolyanski lake group there are already completely drowned lakes, wich are not exist alredy. One of the studied lakes from Chairski Lake group – Chairsko 2 lake was performed into a fish pond and stocked with salmonid fish. Stocking with cyprinids have been conducted in another studied lake from the group – Chairsko 3 lake as well as Smolyanski lake, Matnoto lake is the only non stocked lake among the studied ones.

Some studies are available for the composition of aquatic communities in some of the lakes (Kozuharov 2011, Naidenov, Sais 1983, Karapetkova 1987). Published literature on ichthyofauna summarizes Stefanov (2006). Two are the most informative publications: Naydenov (1975) for zooplankton and Russev, Yaneva (1975) – *for macrozoobenthos composition.* There are no researches on the ecosystems of landslide lakes in the Rhodopes as a whole. Only Nikolova (2005) discussed the biodiversity and the ecological state of these ecosystems in terms of their high conservation value based on published data. Moreover the changes in the natural aquatic ecosystems under antropogenic pressure and impact are the focus of the implementation of the overall European ecological legislation in terms of the aquatic ecosystems using the WFD approach. Thus, the aim of this study is to give the basis of further comprehensive reflection of the changes occuring in the ecosystems of this lakes under antropogenic pressure and impact.

Matherial and Methods

The studied lakes form the two bigest groups of landslide lakes in the Rhodopes mountain – Smolyanski and Chairski lakes. From the first group four were studied: Matno Lake, Bistro Lake, Trevisto Lake and Keranov gyol reservoir. The second group was presented in this research with Chairsko 2 and Chairsko 3 lakes. The geographic coordinates of the objects are represented in Table 1.

The samples of aquatic communities were collected in the springof 2010 for the groups of Smolyanski and in the summer of 2010 for Chairski lake group.

Macrozoobentic samples were collected after the given standards: EN 27828:1994; ISO 9391:1993; EN ISO 5667-1:2006/ AC: 2007 EN ISO 5667-3:2003/ AC: 2007. Also the Cheshmedjiev *et al.* (2011) approach for kick sampling was used. The recent taxonomic status is according to the given in the EOL database *and* Uzunov, 2010.

Quantitative zooplankton samples were collected by all the lakes exept Chairsko 3 lake by filtering of 100 L of water trough Apstein net (70 µm mesh size). The samples were preserved and processed in lab. The taxonomic affiliation is consistent with Kozhuharov, 2007; Segers, 2007; EOL and WORM databases.

Fish was cought using traps for 12 hors and electricity (according to the standard EN 14011: 2003) with wadding sampling strategy The SEN (fa. Bednář, Check) electro-fishing appliance was in use (a rucsac type, 1 fishing anode – 300 mm ring; Pulse Direct Current with 120 W power, 200-500 V voltage, and 50-90 Hz frequency). The determination is consistent with Kottelat, Freyhoff, 2007.

Similarities among the species compositions were tested using clustering and ANOSIM techniques of the software PRIMER v6, according to Clarke, 1993 and Clarke, Warwick 2001. The statistically significant results are commented only. The found taxonomic composition of zooplankton and macrozoobenthos are compared with the seasonaly relevant one only, published in Naydenov (1975) and Russev, Yaneva (1975).

Table 1. Geographic coordinates and altitude of the studied lakes.

Lake	Abbreviation	Geographic coordinates		Altitude
		N	E	
Matno Lake	MSM	41 36 41,85	24 40 10,14	1423
Bistro Laкe	BSM	41 36 36,26	24 40 11,8	1414
Trevisto Lake	TSM	41 36 36,54	24 40 08,59	1419
Keranov gyol Reservoir	KGS	41 36 26,95	24 39 55,64	1382
Chairsko 2 Lake	CHR2	41 35 53,31	24 26 58,11	1465
Chairsko 3 Lake	CHR3	41 35 31,45	24 26 42,44	1343

All the comments on antropogenic pressure and impact are in accordance to the recent definitions used in the european ecological legislation (Guidance Document No 3).

Results and Discussion

Zooplankton communities

A third of the species composition of zooplankton was reported for the first time in the Rhodopes landslide lakes (Table 2).

Matno Smolyansko lake was considered to have the highest number of taxa (Fig.1). Phantom midge *Ch. crystalinus*, which was found in the zooplankton was noted and commented, due to its high importance of the life cycles and trophic structure of the cladoceran species in the lake. Trevisto Smolyansko Lake zooplankton included five of the six groups identified in the lakes studied (Fig.1).

In Bistro Smolyansko lake the taxonomic composition of zooplankton was defined as the poorest, compared to other lakes studied (Fig..1). Both species *A. priodonta* and *A. sieboldi* found in Keranov gyol reservoir have been reported for the first time in Smolyanski group lakes. Naydenov (1975) notes *Asplanchna* sp., probably due to lack of technical ability for species determination of the collected materials. From taxonomical point of view the zooplankton community in Chairsko 2 lake was the second richest among the investigated after that in Matno Smolyansko lake. The rotifers *K. quadrata*, *L.* sp.; *P. quadricornis*; *T. tertractis* and the cladocera *A. nana* were not found in the plankton composition of the group of Smolyan lakes.

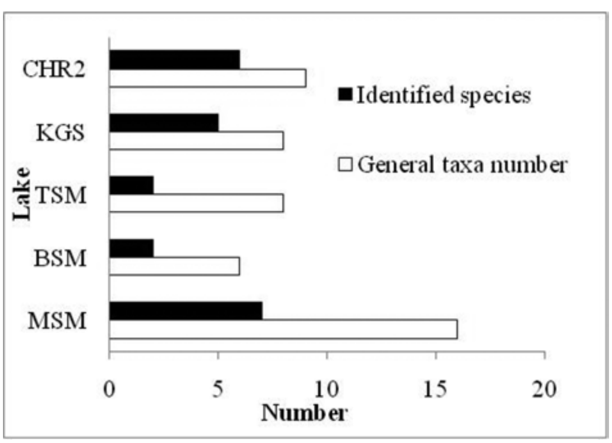

Fig. 1. General taxa number and number of the identified species in the zooplankton of the studied lakes.

Similarity in the taxonomic composition

According to the cluster analysis the composition of zooplankton communities in the lakes studied in 2010 completely differs from the published zooplancton composition in Naydenov 1975 (Fig. 2). The taxonomic composition of zooplankton, indicated by the author, showed significantly lower values of the Jaccard similarity coefficient among the lakes, compared to the current results.

The high level of differentiation between the taxonomic compositions of zooplankton for both periods was found (Fig. 3).

Macrozoobenthos communities

Identified taxa belong to 15 major benthic groups (Table 3). A total of 46 taxa were determined (Table 3, Fig. 4), 23 of them were determined to species, 8 to genus and 11 to family level.

Fifteen of the taxa were reported for the first time in the macrozoobentos of the Rhodopean landslide lakes – 4 species of Oligochaeta, 2 species of Bivalvia, one genus of Ephemeroptera, one species of Plecoptera, 4 species, 1 genera and 2 families of the Trichoptera groups (Table 3). The last published study on macrozoobenthic community is the work of Russev, Yaneva 1975. The composition of the two groups Oligochaeta and Chironomidae we did not found earlier published data. The distinctive highest number of taxa was found in the Matno Smolyansko lake (Fig. 4).

Chironomidae family was represented mainly by subfamilies Chironomini and Tanypodinae- inhabitants of water with relatively high average temperatures than the subfamilies Orthocladiinae and Prodiamesinae (Armitage *et al.* 1997). They were slightly represented and their origin could be found in the stream that flows into the lake. It is interesting to note that in this lake all the three representatives of Bivalvia class was reported togehter. The possible reason not to find them into Trevisto and Bistro lakes, due to the temporary drainage few years ago. The representatives of Trichoptera order belong mainly to Limnephilidae and Phryganeidae families. *C. major* is considered to be inhabitant of lakes and ponds preferably in mountainous regions. Moreover *L. flavicornis* occurs in standing or slow moving waters, small ponds and pools even temporary ones (Waringer, J., W. Graf 2011).

Similarity of taxonomic composition

Low levels of the values of Sörensen similarity coeffi-

Table 2. Taxonomic composition of the zooplankton communities in the lakes studied. Legend: as in Table 1.

Taxa	BSM	MSM	KGS	TSM	CHR2
TESTACEA	-	-	-	-	+
Arcella sp.	-	+	-	+	-
ROTIFERA					
**A. sieboldi* (Leydig, 1854)	-	-	+	-	+
**Asplanchna priodonta* Gosse, 1850	-	+	+	+	-
Brachionidae					
Keratella cochlearis (Gosse, 1851)	-	-	+	-	-
K. quadrata Muller,1786	-	-	-	-	+
**Platyias quadricornis* (Ehrenberg, 1832)	-	-	-	-	+
Lecanidae					
Lecane sp.	-	-	-	-	+
Synchaetidae					
Synchaeta sp.	-	+	-	+	-
Trichotriide					
**Trichotria tertractis* (Ehrenberg, 1830)	-	-	-	-	+
CLADOCERA					
Chidoridae					
Chidorus sphaericus (O.F. Müller, 1785)	+	+	+	+	-
C. sp. juv.	+	+	+	+	-
Alonella nana (Baird, 1850)	-	-	-	-	+
Bosminidae					
Bosmina longirostris O.F. Muller, 1785	-	-	+	-	+
Daphniidae					
Daphnia longispina O.F. Müller 1785	-	+	-	-	-
D.pulex Müller, 1785	+	+	-	-	-
D. sp. juv.	+	+	-	-	-
COPEPODA	-	-	-	-	-
Harpacticoida	-	+	-	-	-
Cyclopoida					
Eucyclops serrulatus (Fischer, 1851)	-	+	-	-	-
Acanthocyclops vernalis (Fischer, 1853)	-	+	-	-	-
Copepoda (nauplii)	+	+	+	+	+
Copepodites	+	+	+	+	+
OSTRACODA					
Ostracoda gen. sp.	-	+	-	+	-
DIPTERA					
Chironomidae gen. sp.	+	-	-	-	-
Chaoborus crystalinus (De Geer 1776)	+	-	-	-	-

cient was reported for each of the two taxonomic compositions of macrozoobenthos – published by Roussev and Yaneva 1975 and registered in the current study (Fig. 5). Statistically significant difference was found between them (ANOSIM-R = 0.83, p = 0.0001). In 2010 the highest similarity values reported were between the communities of Chairski Lakes 2 and 3.

Ichthyofauna

The study recorded a total of five fish species from two families in the composition of the fish fauna of the studied lakes (Table 4).

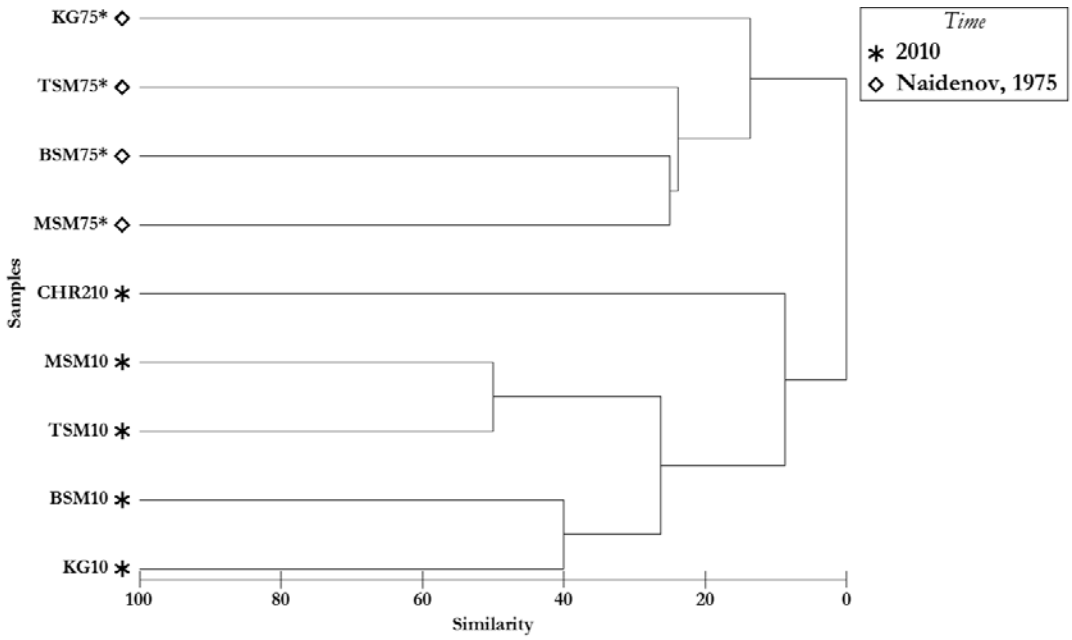

Fig. 2. A dendrogram of an UPGMA cluster analysis of taxonomic similarity of Jaccard in zooplankton in the studied lakes- complete linkage-mode clustering; p= 0.005.

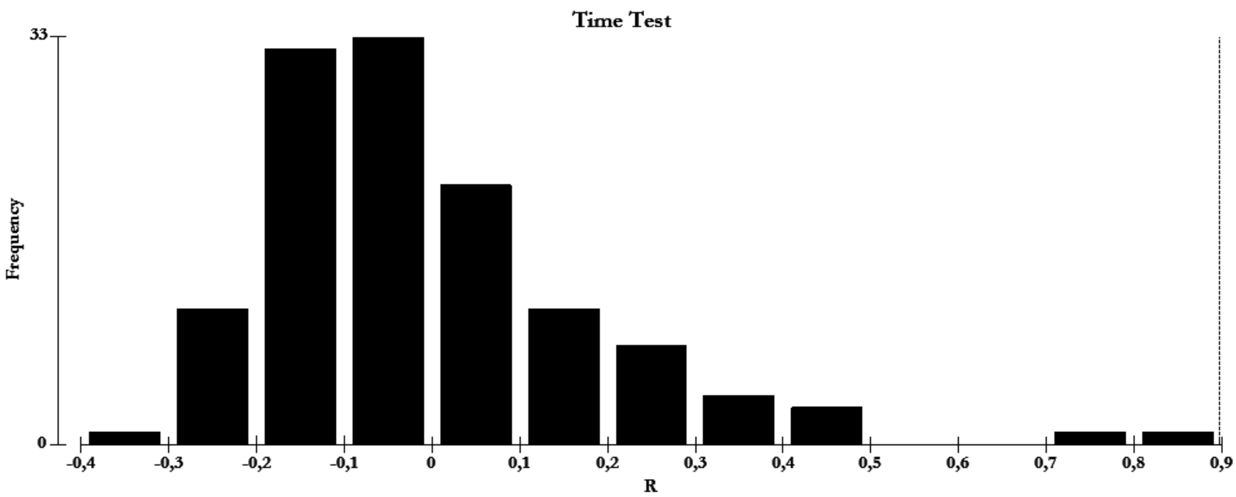

Fig. 3. Distribution of the probability of rejecting the null hypothesis at random rearrangement of the nine species compositions- ANOSIM (p= 0.005 and 125 of the all 126 permutations had levels of significance less than the probability of rejecting the null hypothesis).

Fish were caught in two lakes only – Keranov gyol reservoir and Chairsko 2 lake. In the other lakes fish were not caught. The reason for this fenomenon was probably the above mentioned complete drainage of Trevisto and Bistro lakes a few years ago. For Chairski lakes extremely environmental disadvantages in the factors with high significance for the ichthyofauna (as low dissolved oxygen concentrations, high pH (around 9) and high concentrations of ammonium ions) may explain the poor composition. Furtermore even Karapetkova 1987 mentioned that these lakes are inappropriate for fishing and aquaculture.

Low level of similarity of the published spesies contents and the recent one was found (Fig. 6).

Conclusion

The large number of new reported taxa is probably due to the relatively long period passed since

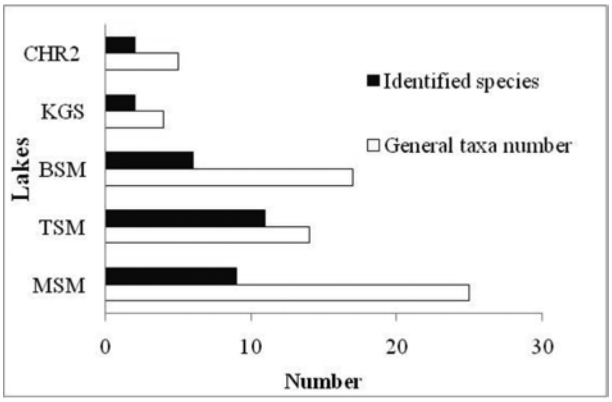

Fig. 4. General taxa number and number of the identified species in the macrozoobenthos of the studied lakes.

the last researches. The significant changes in the aquatic communities most probably could be relied with changes in environmental conditions in the lakes. A more complete investigation of the sites included and seasonal dynamics of zooplankton communities could provide more comprehensive data on biodiversity in lakes, which is of importance for the proper management actions for these aquatic ecosystems with high conservation value.

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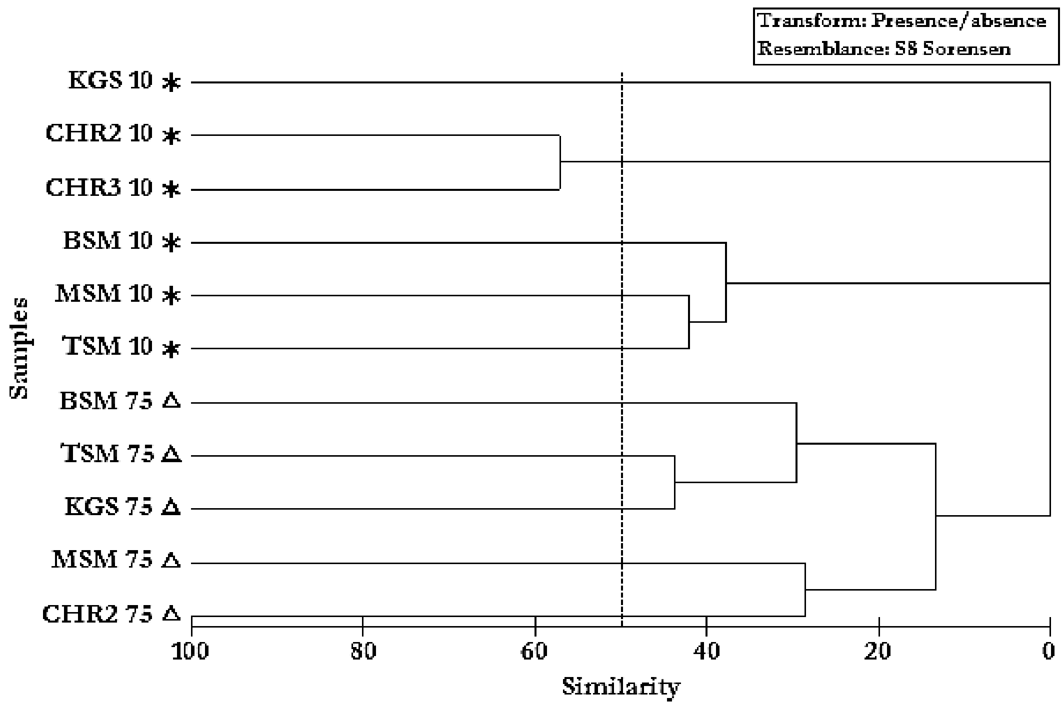

Fig. 5. A dendrogram of an UPGMA cluster analysis of the Sörensen taxonomic similarity in the macrozoobenthos communities withinin the studied lakes- complete linkage-mode clustering; p= 0.005.

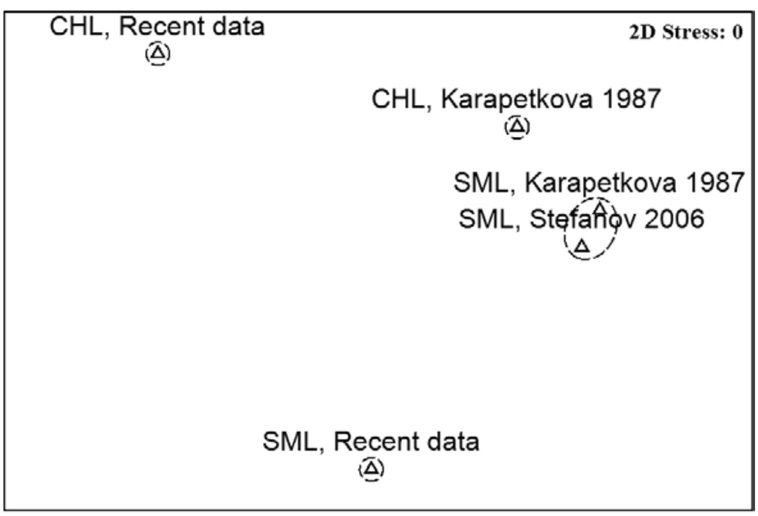

Fig. 6. MDS-plot of the Ochiai simmilarities in the ichthyofauna composition in the studied lakes- recent results, the Maria Karapetkova data (Karapetkova 1987), and the Stefanov data (Stefanov 2006); SML – the Smolyanski lakes; CHL – the Chairski lakes.

Table 3. Taxonomic composition of the macrozoobenthic communities in the lakes studied. With the sign * are the types reported for the first time in the composition. Legend – as in Table 1.

Taxa	MSM	TSM	BSM	KGS	CHR2	CHR3
Nematoda indet.	-	-	+	-	+	+
Ostracoda indet.	-	-	+	-	-	-
Oligochaeta						
**Limnodrylus claparedeanus* Ratzel 1869	-	-	-	+	+	-
**Lumbriculus variegatus* (O.F. Müller)	+	-	+	-	-	-
**Aulodrylus pigueti* Piguet	+	-	-	-	-	-
**Tubifex tubifex* (Müller, 1771)	-	+	-	-	-	-
Hirudinea						
Haemopis sanguisuga (Linnaeus 1718)	-	-	+	-	-	-
Erpobdella octocullata (Linnaeus, 1718)	+	+	+	-	-	-
E. sp.	-	-	+	-	-	-
Dina lineata (O. F. Müller, 1771)	+	-	+	-	-	-
Gastropoda						
Radix sp.	-	-	-	-	+	+
Bythinella sp.	+	-	-	-	-	-
Bivalvia						
**Sphaerium corneum* (Linnaeus, 1718)	+	+	-	-	-	-
**Sphaerium solidum* (Normand, 1811)	+	-	-	-	-	-
Pisidium sp.	+	-	-	-	-	-
Ephemeroptera						
Baetis melanonix (Pictet 1811)	+	-	-	-	-	-
*Siphlonurus sp.	-	-	-	+	-	-
Cloeon dipterum (Linnaeus, 1761)	+	+	-	-	-	-
Plecoptera						
**Nemoura cinerea* (Retzius, 1781)	-	-	-	+	-	-
Odonata Zygoptera						
*Pyrrhosoma nymphul*a (Sulzer, 1776)	+	+	-	-	-	-
Coenagrion pulchellum (Vander Linden, 1811)	-	+	-	-	-	-
Trichoptera						
Limnephilidae						
**Limnephilus flavicornis* (Fabricius, 1787)	-	+	-	-	-	-
**Limnephillus griseus* (Linnaeus, 1718)	+	+	+	-	-	-
Limnephllus rhombicus (Linnaeus 1718)	-	-	+	-	-	-
**Chaetopteryx major* McLachlan, 1876	-	+	-	-	-	-
**Ecclisopterix sp.*	+	-	-	-	-	-
Drusus sp.	-	-	+	-	-	-
Goeridae						
*Goeridae gen. sp.1	-	-	+	-	-	-
Phryganeidae						
*Phryganeidae gen. sp.	-	-	+	-	-	-
**Phryganea grandis* Linnaeus, 1718	+	-	-	-	-	-
Oligotricha striata (Linnaeus, 1718)	-	+	-	-	-	-

Table 3. Continued.

Taxa	**MSM**	**TSM**	**BSM**	**KGS**	**CHR2**	**CHR3**
Sericostomatidae						
Sericostomatidae gen. sp.	+	-	-	-	-	-
Diptera						
Simulidae						
Simuliidae gen. sp.	-	-	-	-	+	-
Chironomidae						
Tanipodinae gen.sp.1	+	-	-	-	-	-
Tanipodinae gen.sp.2	+	+	-	-	-	-
Orthocladinae gen. sp.	+	-	-	-	-	+
Prodiamesinae gen. sp.	+	-	-	-	-	-
Chironomini gen.sp.	+	-	-	-	-	-
Chironomidae indet.	+	-	-	+	-	-
Chaoboridae						
Chaoborus crystalinus (De Geer 1776)	+	-	-	-	-	-
Culicidae						
Culicidae gen. sp.	+	+	-	-	-	-
Dixidae						
Dixidae gen. sp.	-	-	+	-	-	-
Coleoptera						
Dytiscus marginatus Fischer, 1778	-	-	+	-	-	-
Agabus guttatus (Paykull, 1798)	-	+	-	-	-	-
Heteroptera						
Gerris ***sp.***	+	-	-	-	-	+

Table 4. Ichthyofauna composition in the two lakes, where fishes were presented. Legend – as in Table 1.

Taxa	**KGS**	**CHR2**
Percidae		
Perca fluviatilis Linnaeus 1758	+	-
Cyprinidae		
Pseudorasbora parva Temnick & Schlegel 1846	-	+
Rutilus rutilus Rafinesque 1820	+	-
Gobio bulgaricus Drensky 1926	-	+
Barbus cyclolepis Heckel 1840	-	+

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