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The Metazoan plankton of the Biosphere Reserve Srebarna Lake (North-Eastern Bulgaria)

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With 1 Table

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The results of five years of regular observations on the species diversity and quantity of the zooplankton community of the Srebarna Lake are presented - a Biosphere Reserve, World Natural Heritage Site and Ramsar Site of International Importance, located on the Danube bank in North-Eastern Bulgaria. All available faunistic information about the species diversity was associated with the data obtained in 1997-2001 as a part of both the Management Plan for the Srebarna Lake Reserve and a consequent monitoring program. In total, 137 zooplankton taxa have been recorded till today, 92 of them were found for the first time by the present investigations and 31 have been confirmed.

1 Introduction

The Srebarna Lake is a biosphere reserve, listed as UNESCO's World Natural Heritage Site, a Ramsar Site of International Importance and Important Bird Area. Despite of its highly protected status since 1948, during the last 55 years the lake has been affected by many negative factors, but the most catastrophic one was cutting off the water exchange with the Danube as a result of embankment of the riverbank. Because of this and together with accumulation of nutrients from surrounding arable land, the ecological situation has been estimated as a disaster in the early nineties of the last century (Uzunov & al. 2001). A recovery of the aquatic ecosystem was noted after the construction of a feeding canal between the lake and the Danube in 1994 (Hiebaum & al. 2000).

Shishkov (1909) gives information about 3 species of Cyclopidae. Later Naidenow (1965) reported 11 Branchiopoda and 11 Cyclopidae. Konsuloff (1912) published the first data on plankton Rotatoria (11 species) and Naidenow's (1984) treatment of the zooplankton deals also with Rotaria. Kraeva (1992) studied composition and seasonal dynamics of the zooplankton community based on 8 Cladocera, 3 Copepoda, and 9 Rotatoria species. He found *Bosmina longirostris* to be the dominant species 1990-1991; in this period a dramatic impoverishment of the species diversity took place due to the reduction

of the water volume in the Srebarna Lake. The knowledge about the number of species of the lake was summarized in "Biodiversity of the Srebarna Biosphere Reserve. Checklist and Bibliography" (Michev & al. 1998). Concerning the zooplankton 47 species are listed there: 16 Rotatoria, 17 Branchiopoda, and 14 Copepoda.

Our studies of the zooplankton in the Srebarna Lake were carried out 1997 to 2001 as support to the Management Plan for the Srebarna Lake Reserve (Hiebaum & al. 2000) and were part of the consequent monitoring program. The results of these five year of observations are summarized below.

2 Sampling area and methods

The Srebarna Lake is situated on the right bank of the river Danube between river-km 393 and 391. Its area is about 2,5 km² with an open pool of about 1 km², surrounded by reedbeds with some smaller, more or less isolated pools within. The mean depth of the main pool is about 1,2 m, depending on the water influx.

Monthly samples of zooplankton were taken at 5 points, selected to represent different types of habitat, 3 in the central open water body and 2 in the adjacent pools. The sample periods were March-August 1997 (qualitative samples only), May-November 1998, January-December 1999, January-November 2000 and March-December 2001. Samples were taken under the surface layer because of the small depth of the lake and the constant mixing by wind. For quantitative sampling 50 l of water were filtered through a plankton net (90 μm mesh width); the samples were preserved in 4 % formaline. In all, 30 qualitative and 200 quantitative samples were taken.

For the identification of species the following literature was used. Cladocera: Manuylova (1964), Naidenow (1994) (nomenclature); Copepoda: Kutikova & Starobogatov (1977), Monchenko (2003); Rotatoria: Kutikova (1970).

The biomass of plankton crustaceans was calculated by the proportion body length to body weight according to Morduhay-Boltovskoy (Pavlovskiy, Zhadin 1956); for the rotifers the relation between weight, body form and size was used (Chislenko 1968). All quantitative data refer to 1 m³.

3 The current state of Metazoan plankton diversity in Srebarna Lake

A full inventory of the species found by now is presented on Table 1. The results of the present study were compiled with the information from different sources as summarized by Michev & al. (1998).

Our research of the metazoan plankton in the Srebarna Lake yielded a total of 123 taxa (at genus, species and subspecies level). 92 taxa were noted as a first

record, the finding of further 31 taxa was confirmed; 14 species registered in previous investigations were not recaptured. Altogether 137 taxa are known from the lake. The much higher number of taxa registered in the Srebarna Lake during the present study is an effect of more extensive sampling both in space and time. Table 1 shows the remarkable difference of species density from year to year in the period of our research; only 12 species appeared constantly in the community.

Potamoplankton species such as the Rotatoria *Asplanchna sieboldi*, *Brachionus calyciflorus*, *Brachionus diversicornis* and *Keratella cochlearis*, as well as the Copepoda *Eudiaptomus gracilis*, *Acathocyclops robustus*, *Cyclops strenuus* and *Cyclops vicinus* prevailed in the samples. The limnophilous Cladocera were represented mainly by phytophilous and bentho-planktonic species like *Chydorus sphaericus* and *Alona rectangula*. In 1997 and 1998 a species poorness was observed. Compared with earlier data of Naidenow (1984) and Kraeva (1992) some of the widespread species, even families, were absent. In 1999 some species (Sididae, Daphniidae, Polyarthra) reappeared, probably a result of the considerable influx of Danubian water through the feeding canal in late autumn of 1998. During the next three years these species became a permanent component of the zooplankton in the lake. Some Copepoda and Cladocera, typical for the eulimnoplankton, were constantly present in the zooplankton community even though with variable species numbers. From 1997 to 2001 the Rotatoria were the predominating group in terms of species richness.

The faster increase in zooplankton diversity observed in the period of investigations in opposite to the slow succession of the macrozoobenthos reported by Uzunov & al. (2001) may be associated with both the more dynamic environment and a higher reproduction rate of the zooplankton.

With reference to seasonal changes, only few organisms were present throughout the year: *Acanthocyclops robustus*, nauplii and copepodids of both Cyclopoida and Calanoida as well as *Keratella cochlearis* and *Synchaeta sp.* The highest species richness in summer was determined by the increasing species number of Rotatoria whereas the species number of planktonic Crustacea increased mainly in spring and/or autumn.

The highest abundance during our investigation was observed in 1998. But the average number (940 000 ind./m^3) and the biomass (4.1 g/m^3) in that year were much lower than those reported by Kraeva (1992) (4 300 000 ind./m^3 and 47 g/m^3). This difference could be explained as a consequence of the degradation of the water ecosystem in the early nineties as a result of the changes in the dominance structure of the zooplankton community by the immigration of small-sized organisms from the Danube and as an effect of the increased volume of the lake due to the considerable influx of river water in 1998.

Table 1. Zooplankton of Srebarna Lake 1997-2001 and according to references (R)

Taxon	R	1997	1998	1999	2000	2001
ANOSTRACA						
Branchipus schaefferi Fischer						
BRANCHIPODA						
Alona affinis (Leydig)						
Alona rectangula Sars						
Alonella nana (Baird)						
Bosmina longirostris (O. F. Mueller)						
Ceriodaphnia quadrangula (O. F. Mueller)						
Ceriodaphnia reticulata (Jurine)						
Chydorus sphaericus (O. F. Mueller)						
Daphnia cucullata Sars						
Daphnia hyalina Leydig						
Daphnia galeata Sars						
Daphnia longispina O. F. Mueller						
Daphnia pulex (De Geer)						
Daphnia curvirostris Eylmann						
Daphnia sp.						
Diaphanosoma brachiurum Sars var lacustris Lilljeborg						
Disparalona rostrata (Koch)						
Dunhevedia crassa King						
Eurycercus lamellatus (O. F. Mueller)						
Graptoleberis testudinaria (Fischer)						
Leptodora kindtii (Focke)						
Macrotrix sp.						
Moina dubia Guèrne & Richard						
Moina micrura (Kurz)						
Moina rectirostris (Leydig)						
Moina sp.						
Pleuroxus trigonellus (O. F. Mueller)						
Scapholeberis mucronata (O. F. Mueller)						
Simocephalus vetulus (O. F. Mueller)						
COPEPODA						
Eudiaptomus gracilis (Sars)						
Eurytemora velox (Lilljeborg)						
Acanthocyclopc robustus (Sars)						
Cyclops insignus Claus						
Cyclops strenuus Fischer (typ.)						
Cyclops vicinus Uljanin						
Cyclops sp.						
Eucyclops macruroides (Lilljeborg)						
Eucyclops serrulatus (Fischer)						
Eucyclops sp.						
Macrocyclops albidus (Jurine)						
Macrocyclops distinctus (Richard)						
Macrocyclops fuscus (Jurine)						
Megacyclops viridis (Jurine)						
Mesocyclops leuckarti Claus						
Thermocyclops crassus (Fischer)						
Thermocyclops dubowskii (Lande)						
Thermocyclops oithonoides (Sars)						

Taxon	R	1997	1998	1999	2000	2001
ROTATORIA						
Anuraeopsis fissa fissa Gosse						
Asplanchna herricki Guerne						
Asplanchna priodonta Gosse						
Asplanchna sieboldi (Leydig)						
Asplanchna sp.						
Asplanchnopus multiceps (Schrank)						
Brachionus angularis Gosse						
Brachionus budapestinensis Daday						
Brachionus calyciflorus amphiceros Ehrenberg						
Brachionus calyciflorus anuraeiformis Brehm						
Brachionus calyciflorus calyciflorus Pallas						
Brachionus calyciflorus dorcas Gosse						
Brachionus calyciflorus spinosus Wierzejski						
Brachionus diversicornis(Daday)						
Brachionus falcatus Zacharias						
Brachionus forficula Wierzejski						
Brachionus Leydigii rotundus Rousselet						
Brachionus nilsoni Ahlstrom						
Brachionus quadridentatus ancylognathus Schmarda						
Brachionus quadridentatus brevispinus Ehrenberg						
Brachionus quadridentatus cluniorbicularis Skorikov						
Brachionus quadridentatus hyphalmiros Tschugunoff						
Brachionus quadridentatus melheni Barrois & Daday						
Brachionus quadridentatus quadridentatus Hermann						
Brachionus quadridentatus zernovi Voronkov						
Brachionus urceus (Linnaeus)						
Bryceella tenella (Bryce)						
Cephalodella catellina (Mueller)						
Cephalodella pentaplax Wulfert						
Cephalodella sterea (Gosse)						
Colurella sulcata (Stenroos)						
Colurella uncinata (Mueller)						
Colurella sp.						
Conochiloides dossuarius (Hudson)						
Conochilus unicornis Rousselet						
Dicranophorus longidactylum Fadeev						
Dicranophorus rostratus (Dixon-Nutall & Freeman)						
Dicranophorus sp.						
Epiphanes macroura (Barrois & Daday)						
Euchlanis dilatata Ehrenberg						
Fadeewella minuta Smirnov						
Filinia longiseta (Ehrenberg)						
Filinia major (Colditz)						
Filinia passa (Mueller)						
Filinia terminalis (Plate)						
Harringia Rousseleti Beauchamp						
Hexarthra mira (Hudson)						
Kellicottia longispina (Kellicot)						
Kratella cochlearis (Gosse)						
Keratella cochlearis tecta (Gosse)						

Taxon	R	1997	1998	1999	2000	2001
Keratella quadrata (Mueller)	+	+	+	+	+	+
Lecane (s. str.) ludwigii (Eckstein)				+		
Lecane (s. str.) luna (Mueller)				+		
Lecane (s. str.) Stokesii (Pell)				+		
Lecane (Monostyla) bula (Gosse)				+		
Lecane (Monostyla) bula bula (Gosse)						
Lecane (Monostyla) bula diabolica (Hauer)						
Lecane (Monostyla) goniata (Harring & Myers)						
Lecane (Monostyla) lunaris (Ehrenberg)						
Lecane (Monostyla) quadridentata (Ehrenberg)						
Lepadella (s. str.) patella (Mueller)						
Lepadella sp.						
Lophocharis oxysternon (Gosse)						
Mytilina mucronata spinigera (Ehrenberg)						
Mytilina ventralis (Ehrenberg)						
Notholca acuminata (Ehrenberg)						
Platyias patulus (Mueller)						
Platyias patulus patulus (Mueller)						
Platyias polyacanthus (Ehrenberg)						
Platyias quadricornis quadricornis (Ehrenberg)						
Polyarthra dolichoptera Idelson						
Polyarthra luminosa Kutikova						
Postclausa hyptopus (Ehrenberg)						
Synchaeta cecilia cecilia Rousselet						
Synchaeta pachipoda Jaschinov						
Synchaeta pectinata Ehrenberg						
Synchaeta sp.						
Testudinella patina (Hermann)						
Tetramastix opoliensis brevispina Ahlstrom						
Tetramastix opoliensis opoliensis Zacharias						
Trichocerca (s. str.) cylindrica (Imhof)						
Trichocerca (s. str.) elongata Gosse						
Trichocerca (s. str.) longiseta (Schrank)						
Trichocerca (s. str.) mucosa (Stokes)						
Trichocerca (s. str.) rattus carinata (Ehrenberg)						
Trichocerca (Diurella) similis (Wierzejski)					+	
Trichocerca (Diurella) vernalis (Hauer)					+	
Trichotria pocillum bergi (Meisner)					+	
Trichotria pocillum pocillum (Mueller)					+	
Trichotria truncata (Whitelege)			+		+	+
TOTAL: 137	47	27	49	71	72	76

After the construction of the connecting canal in 1994 the ecosystem of the Srebarna Lake is recovering from the strong disturbance in the early nineties and the zooplankton community is restoring its species diversity. It is likely that the future development of the species diversity will be closely dependent on the flooding regime of the Danube.

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