



Changes of Zooplankton Community in the Shallow Floodplain Lake Srebarna (NE Bulgaria) Associated with Seasonal and Long-term Water-level Fluctuations

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Abstract: Lake Srebarna is a shallow lake in the floodplain of the Danube River in NE Bulgaria, which is characterised by strong seasonal and long-term water-level fluctuations. The present study aimed to analyse the impact of the water level on the species richness, abundance and structure of the zooplankton community in this lake. Sampling was done monthly in 1999–2006. Overall, 100 zooplankton taxa were identified, including 71 rotifer and 29 crustacean (11 copepod and 18 cladoceran) species. The seasonal analyses identified specific species assemblages in both rotifers (four assemblages) and crustaceans (three assemblages), alternating along the annual cycle of the plankton community. High water levels facilitated the increase of the abundance of the Rotifera, while such effect was not detected on the Crustacea. The pattern of the dynamics of the abundance of rotifers differed from that of crustaceans and the maxima of the former coincided with the minima of the latter, and vice versa. The water-level fluctuations also affected the composition of the dominant species (both crustacean and rotifer) in the zooplankton community.

Key words: dynamics, Crustacea, Rotifera, Danube floodplain, oxbow lake, freshwater ecosystems

Introduction

A common approach in determining community-structuring factors is the identification of the relationships between environmental factors and characteristics of the communities (species richness, abundance and community structure). Information for such studies is gathered over spatial and (or) temporal scales using a wide range of methods, which may affect interpretation of species interactions in experimental and field studies (LEVIN 1992). Methodology may also influence the temporal resolution of datasets and analyses of interactions in the community (HAMPTON & SCHINDLER 2006).

Water-level fluctuation in lentic water bodies is considered an important community-structuring environmental factor for zooplankton at seasonal

(GOWNARIS et al. 2018, Špoljar et al. 2018) and annual (GOŹDZIEJEWSKA et al. 2016, HU et al. 2019) scale. To study how this environmental factor affects the zooplankton-community structure at different temporal scales, we used a long-term dataset from Lake Srebarna, a shallow floodplain lake situated along the Danube River between rkm 393 and 391, NE Bulgaria (Fig. 1). This lake is connected with the river by an artificial canal and its water level strongly depends on the river flood regime and the canal management (BISERKOV et al. 2016). Investigations of the zooplankton community of Lake Srebarna (NAIDENOV 1965, 1984, 1998) revealed high biodiversity with 234 taxa at the generic, species and subspecies level (PEHLIVANOV et al. 2012). Ecological studies explored the development of the

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zooplankton community in Lake Srebarna over the seasonal scale (KRAEVA 1992) and its dependence on the flood regime (PEHLIVANOV et al. 2004, 2006). Studies on Lake Srebarna found that the annual water-level fluctuations (due to the flood regime of the Danube River) had impact on the structure of phytoplankton (BESHKOVA et al. 2008), zooplankton (PEHLIVANOV et al. 2006), bottom macroinvertebrate (VARADINOVA et al. 2012) and fish (PEHLIVANOV & PAVLOVA 2009) communities.

In the present study, we compare the dynamics of the structure of the zooplankton community in Lake Srebarna at seasonal scale (dynamics within year) and at long-term scale (over a period of eight years) in order to understand the impact of the water-level fluctuations on the species richness, abundance and the structure of the zooplankton community.

Materials and Methods

Overall, 260 zooplankton samples collected during 52 campaigns were analysed. Samples were collected by boat at five stations (Fig. 1), every month during ice-free periods in the course of eight years (1999–2006, Table 1). Each sample was collected by filtering 50 L of water through an Apstein's plankton net (60 µm mesh size) and preserved in 4% formaldehyde solution. Data about the water depth of the lake as an indication for the water-level fluctuations were recorded. Species richness and abundance were estimated based on the average for the five sampling stations. In order to extract both seasonal and yearly patterns, missing data were generated using interpolation. Analyses were implemented in R, v. 2.10.0 (R CORE TEAM 2014). Time-series analyses were performed by pastecs R package, v. 1.3-11 (IBANEZ et al. 2012). Correlations between the extracted seasonal (WD S) and yearly (WD Y) trends in water depth, rotifer species richness (S ROT), crustacean species richness (S CRU), total abundance (A ROT) of rotifers and total abundance of crustaceans (A CRU) were tested with STATISTICA 7.

The impact of water depth on community composition at the seasonal scale and the long-term scale was tested with a redundancy analysis (RDA) in CANOCO for Windows (v. 4.5) (TER BRAAK & SMILAUER 2001). For the analysis of the monthly variation, we used months as the only explaining variable and the values for the overall abundance of rotifers and crustaceans in the zooplankton community as dependent variables. We removed all species, for which less than ten individuals in total were found over the eight-year sampling period (Table 2). We excluded the following crustaceans:



Fig. 1. Lake Srebarna and the five sampling stations. Google Earth history 4/6/2004.

Table 1. Timing of the sampling by month (from January to December) during the eight-year survey in Lake Srebarna.

Months Years	J	F	M	A	M	J	J	A	S	O	N	D
1999						x	x	x	x	x	x	
2000			x	x	x	x	x	x	x	x	x	
2001								x	x	x	x	
2002	x			x	x		x			x	x	
2003				x	x	x	x	x	x	x	x	
2004			x	x	x	x	x	x	x	x	x	
2005				x		x	x			x	x	
2006				x	x			x		x	x	

Acanthocyclops vernalis, *Daphnia cucullata*, *D. pulex*, *Graptoleberis testudinaria*, *Sida crystalina*, *Pleuroxus trigonellus*, *Ceriodaphnia quadrangular*. The rotifers that were not included in the analysis were: *Cephalodella pentalpax*, *Colurella salina*, *Conochiloides deltaicus*, *Dicranophorus forcipatus*, *Kellicottia longispina*, *Lecane levistyla*, *Lecane stenroosi*, *Lepadella patella*, *Lecane quadridentata*, *Mytilina ventralis*, *Platylabus patulus*, *Proales* sp., *Proalides* sp., *Taphrocampa selenura*, *Testudinella patina patina*, *T. p. trilobata*, *Trichocerca longiseta*, *T. iernis*, *T. rattus carinata* and *T. capucina*. In the between-year analyses, the years were used as the only explaining variable. The values for the overall abundance were square-root transformed in all analyses to further decrease the effect of the taxa with the highest abundances.

Results

Overall, 100 species-group taxa were identified (Table 2). These included 71 of the Rotifera and 29 of the Crustacea (11 of the Copepoda and 18 of the Cladocera). The water depth of the lake during the survey was 1.53 ± 0.65 m (av. \pm SD). The annual fluctuations of the water level ranged from 0.53 m in 2002 to 3.63 m in the spring of 2006. The maximum range in water-level fluctuations was of 3.1 m (Fig. 2).

Seasonal trends

Species richness: The seasonal patterns of species richness in rotifers and crustaceans followed similar trends (Fig. 3). The highest number of rotifer species was observed in the late spring, followed by a sharp decline during the summer. A small temporary peak was observed in September, followed by a de-

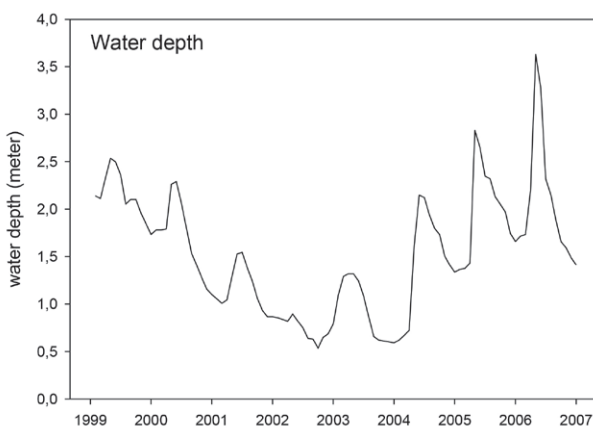


Fig. 2. Long-term dynamics of the water depth as a measure of the water-level fluctuations (based on monthly values) in Lake Srebarna.

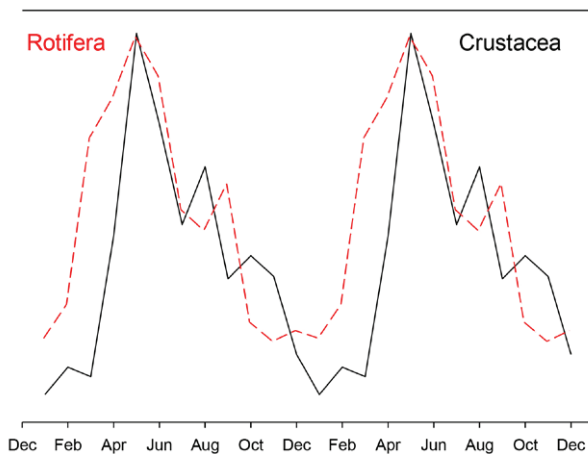


Fig. 3. Seasonal cycle (repeated) of species richness of the crustacean zooplankton (full line) and rotifer zooplankton (striped line) based on average data for 1999–2006. Both assemblages showed maximum of the species richness in spring, followed by a decrease to a minimum in winter.

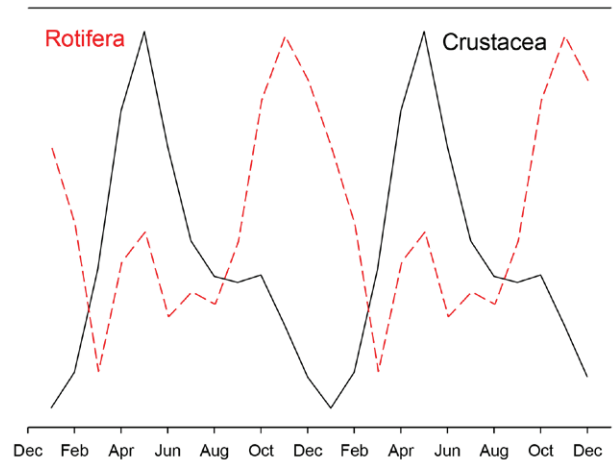


Fig. 4. Seasonal cycle (repeated) of abundance (ind./m³) of the crustacean zooplankton (full line) and rotifer zooplankton (striped line) based on average data for 1999–2006. The Crustacea reached maximum abundance in late spring, followed by a decrease and a minimum in winter. Rotifers showed two periods of maximum abundance: first (small one) in spring and second (higher) in winter.

cline in autumn and reaching the lowest values in the winter. The richness of crustaceans largely followed the same trends but the decline in richness was more moderate. The highest richness of crustaceans was also observed in the late spring, followed by a decline during the summer, with a small temporary peak in August (a little earlier than the peak of rotifers). The species richness of the Crustacea exhibited the minimum values in the winter (January to March).

Abundance: The patterns of seasonal variations of crustacean and rotifer density (Fig. 4) differed from one another. The highest number of rotifers was found in midwinter (around December – January), when the density of crustaceans reached the lowest level. The density of rotifers decreased in March (coinciding with the highest water level) and remained relatively low during the summer, while the density of crustaceans increased and reached the highest annual value in May. In the late summer, the densities of both the crustaceans and the rotifers increased.

Community structure: There was a considerable seasonal variation in the community structure of the crustacean zooplankton in Lake Srebarna over the surveyed period. The sum of all canonical variables explained 31.1% (F-ratio = 2.244, P-value = 0.001) and 29.4% (F-ratio = 2.424, P-value = 0.001) with years as a covariate. The redundancy analyses (Fig. 5A) identified three assemblages of crustaceans distributed along the seasonal pattern. The first assemblage occurred in the winter-spring months (December – April) and was dominated by species of the genera *Cyclops* and *Chydorus*. The second assemblage occurred in late sum-

Table 2. List of the species-group taxa in the zooplankton community in Lake Srebarna used in the present analyses.

ROTIFERA	
<i>Anuraeopsis fissa fissa</i> (Gosse, 1851)	<i>Polyarthra euryptera</i> Wierzejski, 1891
<i>Asplanchna</i> sp.	<i>Polyarthra longiremis</i> Carlin, 1943
<i>Brachionus</i> sp.	<i>Polyarthra luminosa</i> Kutikova, 1962
<i>Brachionus angularis</i> var. <i>bidens</i> Plate, 1886	<i>Polyarthra major</i> Burckhardt, 1900
<i>Brachionus budapestinensis</i> Daday, 1885	<i>Proales</i> sp.
<i>Brachionus diversicornis</i> (Daday, 1883)	<i>Proalides</i> sp.
<i>Brachionus diversicornis</i> var. <i>homoceros</i> (Wierzejski, 1891)	<i>Synchaeta</i> sp.
<i>Brachionus falcatus</i> Zacharias, 1898	<i>Taphrocampa selenura</i> Gosse, 1851
<i>Brachionus forficula</i> Wierzejski, 1891	<i>Testudinella patina</i> var. <i>patina</i> (Hermann, 1783)
<i>Brachionus leydigii</i> var. <i>rotundus</i> Rousselet, 1907	<i>Testudinella patina</i> var. <i>trilobata</i> (Anderson et Shepard, 1892)
<i>Brachionus quadridentatus</i> Hermann, 1783	<i>Filinia opoliensis</i> Zacharias, 1898
<i>Brachionus urceus</i> (Linnaeus, 1758)	<i>Trichocerca capucina</i> (Wierzejski et Zacharias, 1893)
<i>Bryceella tenella</i> (Bryce, 1897)	<i>Trichocerca elongata</i> (Gosse, 1886)
<i>Cephalodella pentaplex</i> Wulfert, 1943	<i>Trichocerca iernis</i> (Gosse, 1887)
<i>Collotheca</i> sp.	<i>Trichocerca longiseta</i> (Schrank, 1802)
<i>Colurella obtusa</i> (Gosse, 1886)	<i>Trichocerca mucosa</i> (Stokes, 1896)
<i>Colurella salina</i> Althaus, 1957	<i>Trichocerca rattus carinata</i> (Ehrnberg, 1830)
<i>Colurella uncinata</i> (Müller, 1773)	<i>Trichocerca similis</i> (Wierzejski, 1893)
<i>Conochiloides coenobasis</i> Skorikov, 1914	<i>Trichotria pocillum</i> var. <i>bergi</i> (Measner, 1908)
<i>Conochiloides deltaicus</i> Rudescu, 1960	<i>Trichotria pocillum</i> var. <i>pocillum</i> (Müller, 1776)
<i>Conochiloides dossuarius</i> (Hudson, 1885)	COPEPODA
<i>Dicranophorus forcipatus</i> (Müller, 1786)	<i>Acanthocyclops robustus</i> (Sars G.O., 1863)
<i>Dicranophorus longidactylum</i> Fadeev, 1927	<i>Acanthocyclops vernalis</i> (Fischer, 1853)
<i>Encentrum</i> sp.	<i>Cyclops strenuus</i> Fischer, 1851
<i>Epiphanes macroura</i> (Barrois et Daday, 1894)	<i>Cyclops vicinus</i> Uljanin, 1875
<i>Euchlanis dilatata</i> Ehrenberg, 1832	<i>Cyclops</i> sp.
<i>Filinia longiseta</i> (Ehrenberg, 1834)	<i>Eudiaptomus gracilis</i> (Sars G.O., 1863)
<i>Filinia major</i> (Colditz, 1914)	<i>Eurytemora velox</i> (Lilljeborg, 1853)
<i>Filinia passa</i> (Müller, 1786)	<i>Graeteriella unisetigera</i> (Graeter, 1908)
<i>Filinia terminalis</i> (Plate, 1886)	<i>Mesocyclops leuckarti</i> (Claus, 1857)
<i>Hexarthra mira</i> (Hudson, 1871)	<i>Thermocyclops dybowskii</i> (Lande, 1890)
<i>Kellicottia longispina</i> (Kellicott, 1879)	<i>Thermocyclops crassus</i> (Fischer, 1853)
<i>Keratella cochlearis</i> (Gosse, 1851)	CLADOCERA
<i>Keratella quadrata</i> (Müller, 1786)	<i>Alona rectangula</i> G.O. Sars, 1862
<i>Lecane bulla</i> (Gosse, 1851)	<i>Bosmina coregoni</i> Baird, 1857
<i>Lecane goniata</i> (Harring et Myers, 1926)	<i>Bosmina longirostris</i> (O. F. Müller, 1785)
<i>Lecane levistyla</i> (Olofsson, 1917)	<i>Ceriodaphnia quadrangula</i> (O.F. Müller, 1785)
<i>Lecane ludwigii</i> (Eckstein, 1883)	<i>Chydorus sphaericus</i> (O. F. Müller, 1776)
<i>Lecane luna</i> Müller, 1776	<i>Daphnia</i> sp.
<i>Lecane lunaris</i> (Ehrenberg, 1832)	<i>Daphnia cucullata</i> G.O. Sars, 1862
<i>Lecane quadridentata</i> (Ehrenberg, 1832)	<i>Daphnia pulex</i> (De Geer, 1778)
<i>Lecane stenroosi</i> (Meissner, 1908)	<i>Daphnia curvirostris</i> Eylmann, 1886
<i>Lepadella patella</i> (Müller, 1773)	<i>Daphnia longiremis</i> G.O. Sars, 1862
<i>Lophocharis oxysternon</i> (Gosse, 1851)	<i>Daphnia longispina</i> (O. F. Müller, 1776)
<i>Mytilina mucronata</i> var. <i>spinigera</i> (Ehrenberg, 1832)	<i>Daphnia galeata</i> Sars, 1863
<i>Mytilina ventralis</i> (Ehrenberg, 1832)	<i>Diaphanosoma brachyurum</i> (Lievin, 1848)
<i>Notholca acuminata</i> (Ehrenberg, 1832)	<i>Graptoleberis testudinaria</i> (Fischer, 1851)
<i>Notommata telmata</i> Harring et Myers, 1922	<i>Leptodora kindtii</i> (Focke, 1844)
<i>Platyias quadricornis</i> (Ehrenberg, 1832)	<i>Moina rectirostris</i> (Leydig, 1860)
<i>Platyias patulus</i> (Müller, 1786)	<i>Pleuroxus trigonellus</i> (O. F. Müller, 1776)
<i>Polyarthra dolichoptera</i> Idelson, 1925	<i>Sida crystalina</i> (O. F. Müller, 1776)

mer (August – September) and was dominated by copepods such as *Achantocyclops vernalis*, *Mesocyclops oithonoides* and *Thermocyclops crassus* as well as by cladocerans such as *Dyaphanosoma brachyurum*, *Leptodora kindti* and *Moina rectirostris*. The most diverse assemblage was found in transitional periods, i.e. early summer and autumn and it was dominated mainly by cladocerans, i.e. mostly representatives of the genera *Alona*, *Bosmina* and *Daphnia* (Fig. 5A).

The structure of the rotifer community also showed considerable seasonal variations. The sum of all canonical variables explained 36.6% (F-ratio = 2.883, P-value = 0.0010) and 34.3% (F-ratio = 3.217, P-value = 0.001) with years as a covariate. The rotifers exhibited four distinct assemblages across the seasons (Fig. 5B): summer (July – September), fall (October, November), winter – early spring (January – March) and late spring (May, June). The cold months from January to March, rotifer zooplankton was dominated by cryophilic species of the genus *Filinia*. Hot months were dominated by large number of species of the genus *Brachionus*. Transitional periods (April – June and October – November) were characterised by domination of species of the genus *Keratella* as well as predatory species of the genus *Synchaeta* in the fall and predatory species of *Asplanchna* in the late spring.

Long-term trends

Species richness: There was no correlation ($R = 0.07$, F-value = 0.465, P-value = 0.497) between the yearly trend of species richness of both Crustacea and Rotifera. However, the two zooplankton groups showed similar trends in species richness over the years (Fig. 6). The intensity of the fluctuations differed but both groups had minima during high water levels (1999 and 2006). Rotifers decreased in species richness in 2003 when the water level was very low. The drop in the species richness of crustaceans was not so pronounced.

Abundance: Yearly dynamics of the abundances of rotifers and crustaceans were negatively correlated ($R = -0.503$, F = 37.95, $p < 0.001$). When the abundance of the Crustacea was high, the Rotifera exhibited low abundance, and vice versa (Fig. 7).

Community structure: The community structure of crustaceans and rotifers showed considerable variations between the years (Figs. 8A, 8B). Canonical axes explained 19.5% of the variation in the dataset (F-ratio = 1.624, P-value = 0.005) and 17.6% (F-ratio = 1.867, P-value = 0.001) based on years as a covariate for the community of crustaceans. Canonical axes also explained 20.7% (Trace = 0.207, F-ratio = 1.751, P-value = 0.008) of the variation in the community of rotifers and 18.4 % (F-ratio = 2.221, P-value = 0.001) based on years as a covari-

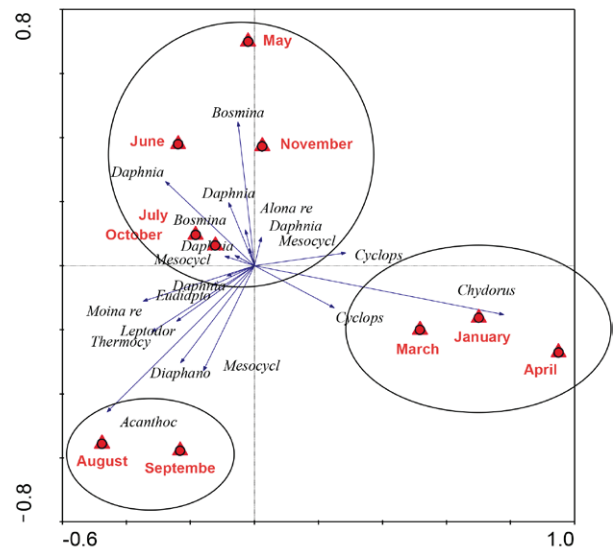


Fig. 5A. Redundancy analysis (RDA) of the generic structure of crustaceans (based on average abundance) with the months as an explanatory variable. Crustacean zooplankton forms three distinct assemblages: one in the late summer (August and September), one in winter – early spring (January – April) and an assemblage characteristic for transitional periods, i.e. late spring (May – July) and autumn (October – November).

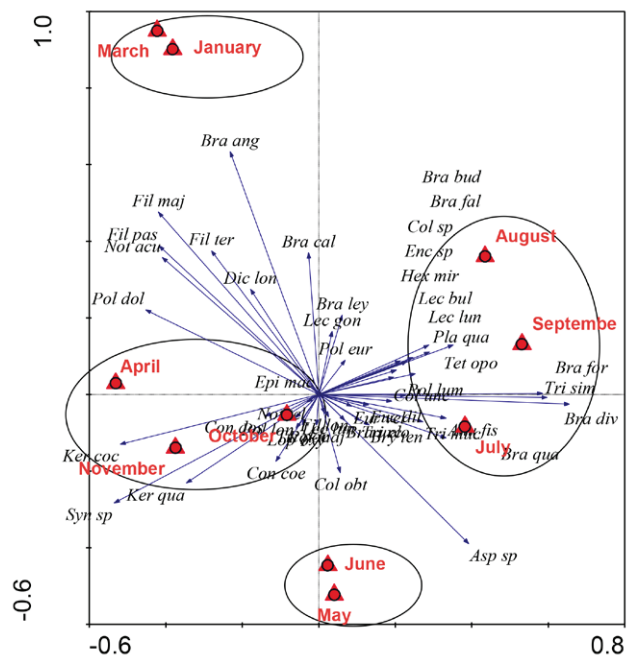


Fig. 5B. Redundancy analysis (RDA) of the structure of rotifers (based on average abundance of species) with the months as an explanatory variable. Four assemblages are outlined, two of them characteristic for colder months (in the left side of the diagram) and two characteristic for the warmer months (in the right side of the diagram). $R=36.4\%$.

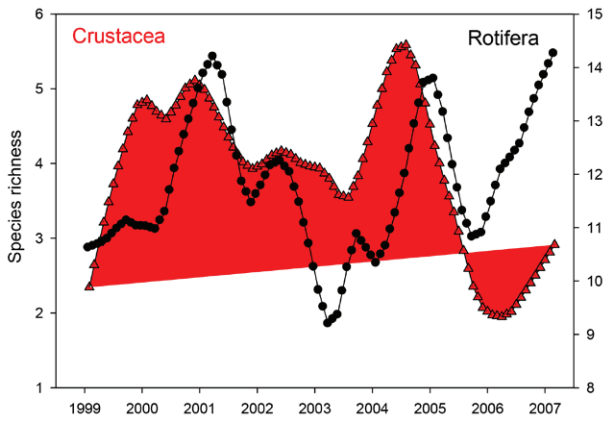


Fig. 6. Monthly trends in species richness of crustaceans (triangles) and rotifers (circles) every over a period of eight years.

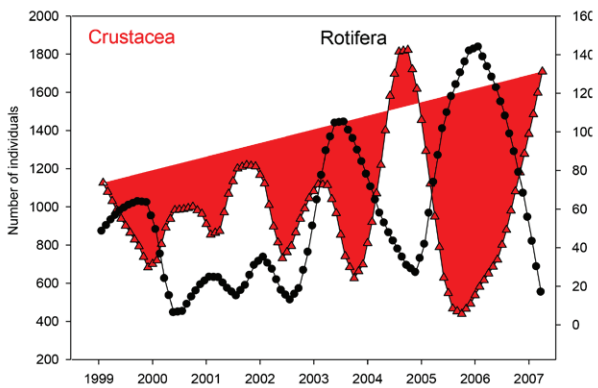


Fig. 7. Trends in the Crustacea (triangles) and the Rotifera (circles) abundance (ind/m³) every month over eight years.

ate. In the years with high water levels, cladocerans of the genera *Daphnia* and *Bosmina* and copepods of the genera *Mesocyclops* and *Thermocyclops* dominated the crustacean community (Fig. 8A). In the years with low water levels, the species prevailing in the crustacean assemblage were more diverse. Concerning the rotifers, in the years with high water level, the dominating species were *Conochiloides dossuarius*, *Keratella cochlearis*, *Synchaeta* sp. and *Hexarthra mira*, while in the low water-level years the prevailing species were more diverse (Fig. 8B).

Correlations with changes in water level

At the seasonal scale, a strong negative correlation was found between the water-depth and the abundance of rotifers as well as a positive correlation between the number of rotifer species and the water depth (Fig. 9). This contrasted to the positive correlation between the water depth and the abundance of crustaceans. Negative correlations between the abundance and the species richness were found for both Rotifera and Crustacea.

At the long-term scale, a positive correlation between the abundance of rotifers and the water

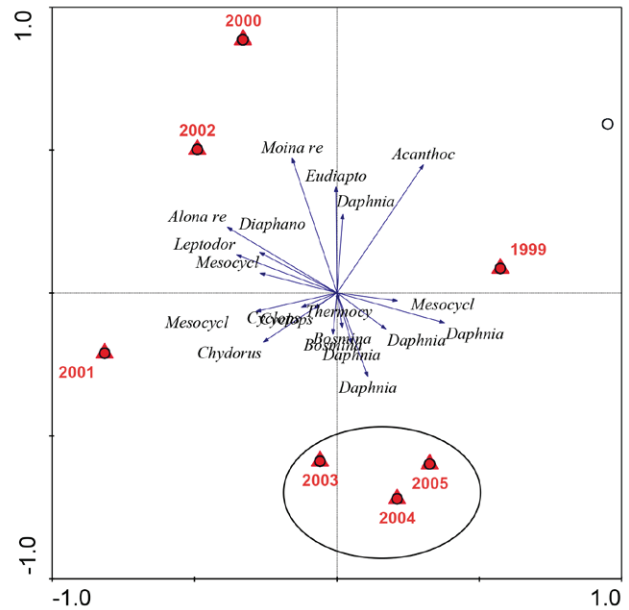


Fig. 8A. Redundancy analysis (RDA) of the generic structure of crustaceans (based on the average abundance) with the years as an explanatory variable explaining 19.5% of the variation.

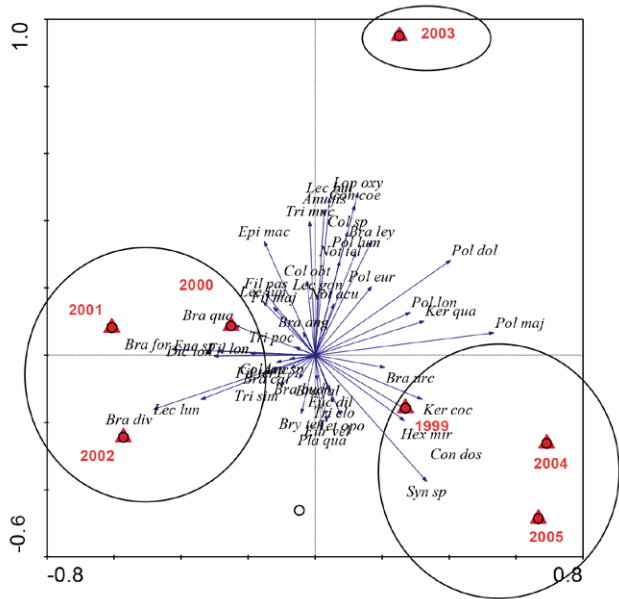


Fig. 8B. Redundancy analysis (RDA) of the structure of the Rotifera (based on average abundance of species) with the years as explaining variable explaining 20.7% of the variation.

depth as well as a negative correlation between the abundance of crustaceans and the water depths were revealed. At the long-term scale, we found a positive correlation of the abundance and the species richness of crustaceans.

The redundancy analysis showed an association between the community structure of rotifers and the water depth at both seasonal scale (Trace = 0.038,

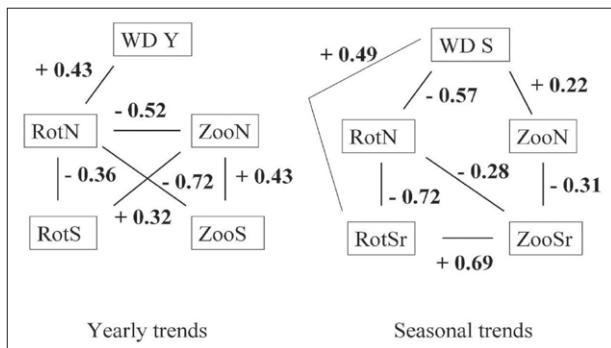


Fig. 9. Schematic overview of the significant correlations ($p < 0.05$) for the seasonally-extracted data series (right) and the yearly-extracted trends (left). R-values of the significant correlations between water-depth (WD), abundance of rotifers (RotN), species richness of rotifers (RotS), abundance of crustaceans (ZooN) and species richness of crustaceans (ZooS) are presented.

F-ratio = 2.324, P-value = 0.024) and long-term scale (Trace = 0.076, F-ratio = 6.013, P-value = 0.001). The seasonal variation in the structure of the crustacean community was not correlated with the water depth (Trace = 0.016 F-ratio = 0.956, P-value = 0.458). The long-term variation in the community structure of crustaceans was associated with the fluctuating water level (Trace = 0.029, F-ratio = 1.934, P-value = 0.030).

Discussion

The changes of the water depth of Lake Srebarna are a result of the water-level fluctuations associated with the balance between the discharge of the Danube River (flood regime), the ground- and surface- water feeding from the lake watershed and the evapotranspiration (BISERKOV et al. 2016). The seasonal changes in the water depth are more predictable than the yearly changes and are characterised by high water levels in spring due to snow melting in the watershed and low water levels in summer due to the evapotranspiration associated with high temperatures. The water-level fluctuations of Lake Srebarna over the years depend mainly on the flood regime of the Danube River because of the climate characteristics responsible for the dynamics of precipitations within the Danube River basin and the dynamics of the ambient temperatures.

After the commissioning of the hydraulic system reconnecting Lake Srebarna with the Danube River in 1994, the flood regime of the river is considered as the main driver of the aquatic ecosystem recovering and succession (PEHLIVANOV et al. 2006, BESHKOVA et al. 2008, VASILEV et al. 2008, PEHLIVANOV & PAVLOVA 2009, BISERKOV et al. 2016).

Changes in the water depth of Lake Srebarna affect significantly the community structure, species richness and abundance of rotifer and crustacean zooplankton at both seasonal and long-term scale. At the seasonal scale, we have observed that crustaceans reach the highest density in April and May, just before the outbreak of actively feeding Young-of-the-Year fish (YOY). Overall, we have found that the zooplankton community exhibits a seasonal succession and the seasonal trends in abundance and species richness largely follow the steps in the PEG model (SOMMER et al. 1986). As predicted in the PEG model, in the spring, the rotifer densities decrease and the crustacean densities increase to reach a peak in May. Further, the herbivorous plankton species become food-limited by their predation on phytoplankton and their density decreases, accelerated by fish predation, mainly by YOY. After the density peak in May, crustacean densities rapidly decline, slowly stabilising in autumn (September – October) followed by a winter minimum. The minimum in densities of cladocerans benefits the increase of the densities of rotifers, reaching a peak in the end of the winter (October – January). After the high spring waters triggered by the inflow from the Danube River (February – March), a decrease of the rotifer densities occurs. The numbers of species of both rotifers and crustaceans in the water column follow similar seasonal patterns, i.e. increasing along the rising water temperature, reaching an absolute maximum in May and steadily decreasing afterwards to a minimum in December – January (Fig. 4).

Additionally, the species number in the zooplankton community in Lake Srebarna can also be affected by high water levels at both seasonal and long-term scales, e.g. through the import of organisms through surface and (or) underground waters (PEHLIVANOV et al. 2006). An example is the stygobiotic species *Graeteriella (s.str.) unisetigera*, which has been recorded in the zooplankton only once during a rising-water-level period, although with significant numbers.

A negative correlation between the water-depth and the total abundance of phytoplankton has been revealed for the same lake (BESHKOVA et al. 2008). As far as most of crustaceans feed on phytoplankton, this suggests that the water level can be an indirect factor controlling the abundance of crustaceans through the food web. On the other hand, the zooplankton abundance and structure may not be strongly affected by fish predation. During low-water level, omnivorous fish species, which predominate the fish community structure in Srebarna, switch to feeding mostly with macrozoobenthos, vegetation and detritus instead of zooplankton (PEHLIVANOV &

PAVLOVA 2012), allowing the crustacean zooplankton to thrive and outcompete the rotifer zooplankton.

Our results on the zooplankton in Lake Srebarna reveal specific species assemblages for both rotifers (four assemblages) and crustaceans (three assemblages) alternating along the annual cycle of the plankton community. However, the long-term observations provide more robust evidence than the seasonal observations (carried out within one year) in terms of revealing general patterns. The long-term observations allow elucidating effects of the water-level fluctuations on the species richness, abundance and community structure of the main zooplankton groups, i.e. rotifers and crustaceans. The dynamics of the species richness in both rotifers and crustaceans follows similar patterns. High water levels facilitate the increase of the abundance of rotifers but no such effect was detected relative to the crustaceans. The pattern of the dynamics of the abundance of rotifers differs from that of the crustaceans and the maxima of the former coincide with the minima of the latter, and vice versa. The water-level fluctuations also affect the composition of the dominating species (both crustaceans and rotifers) in the zooplankton community.

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