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Changes in rotifer communities regarding to the water-level fluctuations in the floodplain Gemenc, Danube (Hungary)

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Abstract. The planktonic rotifer communities in three hydrodynamicaly different river-arms at the floodplain of the Danube river at Gemenc have been studied. In the numerous arms the current has different speeds depending on the water level, therefore the physical and chemical parameters (temperature, conductivity, transparency, dissolved oxygen content) are different. We have found forty-six rotifer taxa in the area, but the species-composition changes seasonally. There are therefore big differences in the qualitative and quantitative data between the main arm and the other branches. At high water levels (flood), the rotifer communities of the area are uniformized but, at low water levels the area becomes divided into a series of different water bodies, some near to the lake-state. This phenomenon develops a few days after the flood. The species composition and the abundance relations of the planktonic rotifer communities reflect this effect.

Gemenc, a part of the Duna-Dráva National Park lies between the 1500th and 1470th river kilometers of the River Danube and is about 5-10 km wide and 30 km long. This type of area, which covers 18000 hectars is unique in Central Europe. Various characteristic river-arms and backwaters are there in different states, which are lying completely on the floodplain. In this reach of the Danube the mean discharge is about 2260 m^3/sec, with the minimum discharge at 470 m^3/s, and floods at 8700 m^3/s. The stream gradient is 5 cm/km, the mean velocity is 0.5-1.2 m/s. The difference is near 800 cm between the extreme values of the water-level fluctuation. Depending on the water-level extreme hydrodynamical processes occur in this area, owing to the numerous other river arms, backwaters and lakes.

PREVIOUS RESEARCH IN THE AREA, AND PURPOSE OF THE PRESENT STUDY

BARTSCH was the first, who reported data about Rotifers from this area in 1877 (BARTSCH, 1877). In 1951 VARGA worked on Gemenc's Rotifer-fauna. His examinations covered other river arms too, which were not examined by us. He found forty-three euplanctonic and fifty-five tychoplanctonic species. (KOL & VARGA, 1960). In 1991 GULYÁS listed fifty-nine species from the Rezéti-Holt-Duna, the Vén-Duna and the main arm (GULYÁS et al., 1991).

We started our study in 2001. Our purpose is to find, besides the faunistical data, the spatio-temporal pattern, the connection to the stream-flow regime and to the chemical-physical parameters, if these connections exist. Our goal is to unravel the above data during several years of examination.

MATERIAL AND METHODS

The study area

Our study area in Gemenc's floodplain contains three river-arms, in downstream succession: Grébeci-Holt-Duna (GDU) (~7 km), Rezéti-Holt-Duna (RDU) (~15 km), and Vén-Duna (VDU) (~5 km) (Fig. 1). Grébeci-Holt-Duna is classified as plesiopotamon (ROUX, 1982). The upstream end is usually closed, and connected again to the main arm in periods of higher water-levels. At low water conditions the

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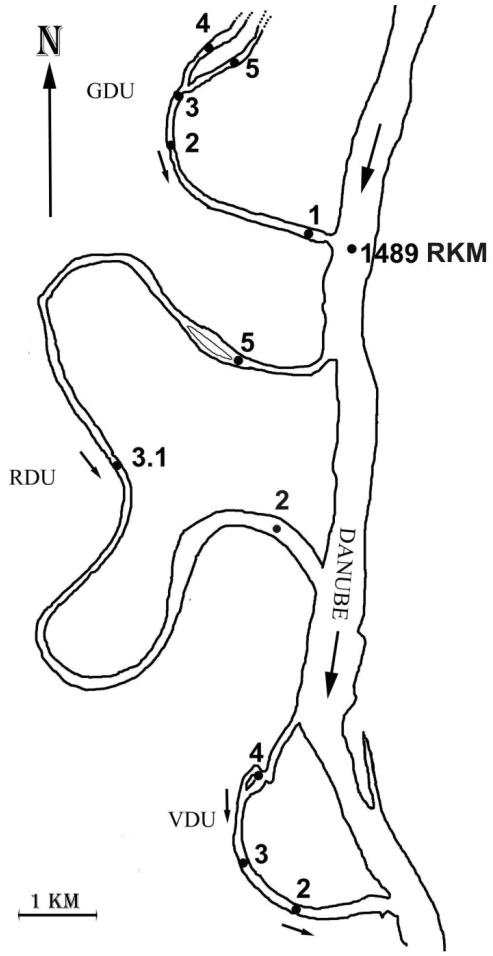

Figure 1. The study area with the sampling sites

conductivity is higher than in the main arm. Thermal stratification can be observed. The depth at mean water-level is about 100-300 cm. Rezéti-Holt-Duna is fully connected at all times, it is a parapotamon-type river-arm with 25-40 m width and 150-400 cm depth at mean water-level. The relatively long extension of this arm and its shallowness are such that the water entering from the main arm changes gradually so to finally posses differing physical and chemical characteristics when compared to the main channel. Vén-Duna finally is a much shorter, parapotamon-type river-arm with running water all over the year. The width is 25-30 m, the depth is about 10-12 m at mean water-level.

Samples were taken between August 2001 and November 2002 at monthly intervals, as far as it was possible. We selected five sampling sites along GDU, three along RDU, three along VDU 3 and one in the main arm (river km 1489) (Fig. 1). We measured, on each occasion the temperature, the pH, the conductivity, the oxygen-content and the oxygen saturation with a WTW Multi 340i instrument. Two 20 litre samples were collected, one was taken to the laboratory without preserving for identification (BANCSI, 1986), (DUMONT, 1995), the other was instantly preserved in 4 % formaldehyde solution.

Data analysis

After the identification of the Rotifer taxa, the preserved animals were counted in a Sedgewick-Rafter chamber. The SYN-TAX 5.1 Multivariate Statistical Program Package (PODANI, 1993) was used to analyse our data. Several analyses were run and evaluated with SYN-TAX on the database. The temporal and spatial comparisons between samples were based both of presence absence and quantitative data. A distance matrix was created using Euclidean distances and chord distances. Qualitative data were analysed with their standard deviation (log_2). Ordination was carried out using non-metric multi-dimensional scaling (NMDS). Hierarchical classification was carried out using the unweighted pair group method (UPGMA) within distance optimalisation.

RESULTS

During the first year of the study 46 taxa of Rotifers were found (Table 1) Several taxa listed in the table 1. occurred for the first time in this area. *Brachionus angularis f. aestivus* SKORIKOV is a new addition to the Hungarian fauna.

The multivariate data-analysis shows, that the Rotifer-fauna of the study area undergoes seasonal changes. The sampling sites form 3 characteristic groups (Fig. 2).

Table 1. List of Rotifera found at Gemenc

1. *Asplanchna girodi* DE GUERNE 1888
2. *A. priodonta* GOSSE 1850
3. *A. sieboldi* LEYDIG 1854
4. *Brachionus angularis f. aestivus* SKORIKOV 1914
5. *B. angularis f. angularis* GOSSE 1851
6. *B. angularis f. bidens* PLATE 1886
7. *B. budapestiensis f. budapestiensis* DADAY 1885
8. *B. budapestiensis f. punctatus* HEMPEL 1896
9. *B. calyciflorus f. amficeros* EHRENBERG 1838
10. *B. calyciflorus f. anuraeiformis* BREHM 1909
11. *B. calyciflorus f. calyciflorus* PALLAS 1766
12. *B. calyciflorus f. dorcas* GOSSE 1851
13. *B. calyciflorus f. spinosus* WIERZEJSKI 1891
14. *B. diversicornis* DADAY 1883
15. *B. falcatus* ZACHARIAS 1898
16. *B. leydigi f. leydigi* COHN 1862
17. *B. quadridentatus var. cluniorbicularis* SKORIKOV 1894
18. *B. quadridentatus var. brevispinus* EHRENBERG 1832
19. *Chromogaster ovalis* BERGENDAL 1892
20. *Conochilus dossuarius var. dossuarius* HUDSON 1875
21. *Euchlanis dilatata* EHRENBERG 1832
22. *Filinia longiseta* EHRENBERG 1834
23. *F. terminalis* PLATE 1886
24. *Hexarthra mira* HUDSON 1871
25. *Kellicottia longispina* KELLICOTT 1879
26. *Keratella cochlearis var. cochlearis* GOSSE 1851
27. *K. cochlearis var. macracantha* LAUTERBORN 1900
28. *K. cochlearis var. robusta* LAUTERBORN 1900
29. *K. cochlearis var. tecta* GOSSE 1886
30. *K. irregularis f. connectens* LAUTERBORN 1900
31. *K. quadrata var. quadrata* O. F. MÜLLER 1786
32. *K. quadrata var. frenzeli* ECKSTEIN 1895
33. *K. tropica f. tropica* APSTEIN 1907
34. *Lepadella patella* O. F. MÜLLER 1826
35. *Notholca labis f. labis* GOSSE 1887
36. *Polyarthra longiremis* CARLIN 1943
37. *P. major* BRUCKHARDT 1900
38. *P. minor* VOIGT 1904
39. *P. vulgaris* CARLIN 1943
40. *Synchaeta longipes* GOSSE 1887
41. *S. pectinata* EHRENBERG 1832
42. *S. stylata* WIERZEJSKI 1893
43. *S. tremula* O. F. MÜLLER 1786
44. *Trichocerca rattus* O. F. MÜLLER 1776
45. *T. pusilla* LAUTERBORN 1898
46. *Trichotria tetractis var. tetractis* EHRENBERG 1830

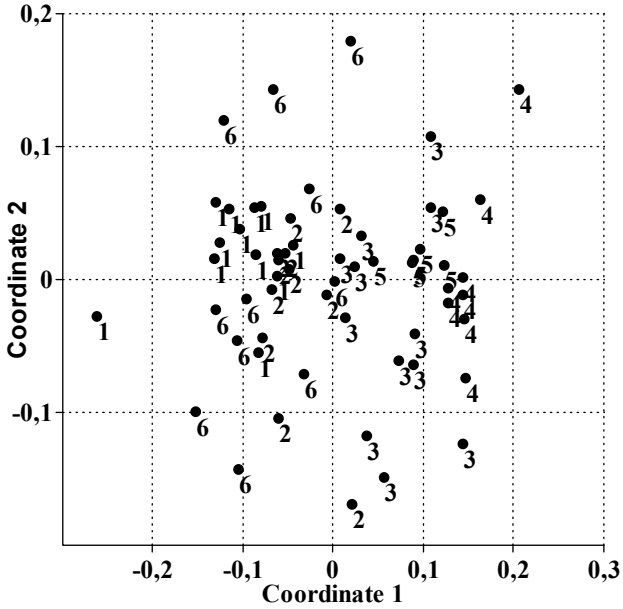

Figure 2. Ordination plot of NMDS analysis. The numbers denote the samples, which where collected at the same date

Comparing the quantitative data the species list can be divided into 3 groups, which contain species and forms in similar constancy and abundance:

1. Rare species and forms with low abundance (*Asplanchna girodi*, *Brachionus falcatus*, *Kellicottia longispina*, *Brachionus angularis f. aestivus*).
2. Rare species and forms with high abundance (*Filinia longiseta*, *Keratella tropica*, *Brachionus budapestiensis f. budapestiensis*).
3. Frequent species and forms with high abundance (*Brachionus angularis bidens*, *Keratella cochlearis tecta*, *Keratella cochlearis cochlearis*).

The physical and chemical parameters measured at the same time as the sampling indicate the difference between the river-arms (Table 2).

Table 2. The physical and chemical parameters measured at the same time as the sampling

04.08.2002.	**VDU2**	**VDU3**	**VDU4**	**RDU2**	**RDU3.1**	**RDU5**	**GDU1**	**GDU2**	**GDU3**	**GDU4**	**GDU5**	**1489**
Temperature (°C)	9,4	11,1	9,3	10	9,6	9,4		10,4		10,2	9,4	9,7
pH	8,4	8,1	8,4	8,4	8,4	8,4		8,4		8,4	7,5	8,4
Conductivity (µs/cm)	454	463	446	452	450	449		386		373	561	447
Oxigen content (mg/l)	11,1	10,7	10,1	11,5	11,5	11,8		12,8		13,1	12,1	12,1
Oxigen saturation (%)	97	96	88	101	100	103		114		116	105	106
05.02.2002.	**VDU2**	**VDU3**	**VDU4**	**RDU2**	**RDU3.1**	**RDU5**	**GDU1**	**GDU2**	**GDU3**	**GDU4**	**GDU5**	**1489**
Temperature (°C)	16,7	15,7	15,5	16,9	16,4	15,8	20,7	21,9	22,2	24,8	22,6	15,7
pH (µs/cm)	7,99	7,89	8,61	8,48	8,51	8,56	8,63	8,42	8,46	8,25	7,96	8,63
Conductivity	416	421	418	427	420	415	498	534	564	510	821	498
Oxigen content (mg/l)	14,51	14,89	14,58	15,39	17,35	15,68	18,32	18,37	16,73	11,39	13,52	12,13
Oxigen saturation (%)	148,3	150,9	147,6	163,3	177,2	158,1	207	219	195,4	139	158,6	122,8
06.13.2002.	**VDU2**	**VDU3**	**VDU4**	**RDU2**	**RDU3.1**	**RDU5**	**GDU1**	**GDU2**	**GDU3**	**GDU4**	**GDU5**	**1489**
Temperature (°C)	20,2	19,1	19,1	21,7	20,1	19,5	22,1	24,7	24,2	26,8	25,1	19,3
pH	8,54	8,6	8,63	8,88	8,78	8,65	8,99	8,54	8,69	8,65	8,82	8,77
Conductivity (µs/cm)	361	365	363	364	363	364	319	351	41	463	518	362
Oxigen content (mg/l)	11,85	14,28	13,08	14,13	13,09	15,7	22,2	17,14	23,3	17,93	26,2	14,28
Oxigen saturation (%)	131,6	157,4	142,4	162,4	142,1	168,8	261	210	275	224	295	155,5
07.03.2002.	**VDU2**	**VDU3**	**VDU4**	**RDU2**	**RDU3.1**	**RDU5**	**GDU1**	**GDU2**	**GDU3**	**GDU4**	**GDU5**	**1489**
Temperature (°C)	23,8	23,4	23,3	26,7	25,3	25,3	31,2					23
pH	9,2	9,1	9,1	8,5	9,2	9,2	8,2					9,1
Conductivity (µs/cm)	317	322	323	326	307	312	509					318
Oxigen content (mg/l)	13	11,5	11,7	13	17,8	16,1	15,8					13
Oxigen saturation (%)	155	137	139	165	220	199	216					153
11.12.2002.	**VDU2**	**VDU3**	**VDU4**	**RDU2**	**RDU3.1**	**RDU5**	**GDU1**	**GDU2**	**GDU3**	**GDU4**	**GDU5**	**1489**
Temperature (°C)	7,8	7,8	7,8	8	8	7,8	8	7,8	7,6	8	7,8	8
pH	8,31	8,2	8,28	8,3	8,37	8,33	8,08	8,16	8,13	8,22	8,24	8,32
Conductivity (µs/cm)	422	422	423	417	425	428	444	437	432	452	420	425
Oxigen content (mg/l)	5,49	5,42	5,76	5,84	5,84	6,43	5,21	5,13	5,11	6,16	5,78	6,35
Oxigen saturation (%)	46,3	45,7	48,8	49,8	49,8	54,4	44,2	43	43	52,7	48,9	55,2

DISCUSSION

We analyzed the relations between our samples (12 sampling sites, about 130 sample) by multivariate methods and we found, that the examined river-arms form 3 functional groups:

1. "Eupotamon" type, which has flowing water whatever the water-level, and has the same physical-chemical parameters as the main arm. The quantitative and qualitative properties of the planktonic rotifer assemblages are similar to the main arm (the upper reach of the Rezéti-Holt-Duna (RDU) and the Vén-Duna (VDU), and of course the main arm).
2. "Parapotamon" type where streaming water is also flowing, but where are differences in the physical, chemical and hydrodynamical parameters when compared to the eupotamal reaches (at the lower reach of the RDU and the VDU).
3. "Plesiopotamon" type, where contact exist with the main arm only at the downstream end at mean or low water-level. Grébeci-Holt-Duna (GDU) belongs to this group. There are marked differences in the

physical-chemical parameters at the sampling sites, which are reflected in the qualitative-quantitative properties of the planktonic rotifers too. For example on the 2nd of May, 2002 the conductivity at GDU4 was 510 μS/cm and at GDU5, (only 50-60 meters farther upstream GDU4) it was 821 μS/cm.

In the first year of our study, the species-composition and the quantitative relations of the samples could be characterized generally by the seasonal changes. The local fundamentals contributed to this main factor, but this effect was not so intense, as we expected. The species composition of rotifer assemblages depended rather on sampling date than sampling site (SCHÖLL, 2002). We could not find any significant relationship between water-level and Euclidean distance among samples, but it does not mean, that the period directly before the sampling time did not influence the hydrochemical relations and the planktonic rotifer assemblages. An improved understanding of the relations between the hydrological regime and planctonic rotifer assemblages requires more data possibly another yearly set.

In conclusion, we can say that comparing the rotifer fauna of the main arm to the other river-arms, the species-composition is similar, but the abundances in the branches are higher, this depending on the water retention.

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