ROTIFERS OF THE MOST POLLUTED POOL OF BACKWATER „GYÁLAI-HOLT-TISZA”, COMPARED TO THE NEIGHBOURING SITE’S FAUNA

J. Márton

Márton, J. (2007): Rotifers of the most polluted part of backwater „Gyálai-Holt-Tisza”, compared to the neighbouring site’s fauna. – *Tiscia 36, 3-6.*

Abstract. The investigation was about the Rotatoria fauna of the most polluted pool of Gyálai-Holt-Tisza, the „Fekete-víz”. The aim was to find the most important factors that form the rotifer fauna at this pool. Sampling took place between April and October, 2005, in 4 periods. Five sampling sites were set out, 4 of them were at „Fekete-víz”, and the fifth at the neighbouring pool, „Fehér-part”, which served as a control site, as the earlier investigations showed the differences between them. Thirty-one Rotatoria-taxa were identified (20 species, 10 genera and a class). During the last examination (Rédei 2002) only 11 species were found. PCA and cluster-analysis distinguished the samples of the periods, which means seasonality, but 4 of the 5 sampling sites overlapped, and one partly overlapped, which means that spatial differentiation occurred only at one site. Rotifers reached peak in density in the summer, while in the autumn period there were almost no individuals in the 3 sites between „Hattyasi átjáró” and the sluice of „Fehér-parti átjáró”. No correlation was found between the measured water parameters and the number of rotifers. The opened or closed state of the sluice of „Fehér-parti átjáró” seems to be the most important factor to influence the fauna: during opened periods large number of rotifers flow into the pool. After closing, the number decreases fast due to the water quality (toxicity of the thermal inflow, low dissolved oxygen content) or some invertebrate predators. The exception was the site farthest from the sluice, where specific dynamics were discovered, with no or little influence of the sluice. The investigations showed that the water of „Fekete-víz” between the sluice and „Hattyasi átjáró” is as heavily polluted that rotifers cannot survive in it without refreshing the water.

Keywords: disturbed water, species composition, species dynamics, salt load

J. Márton, Department of Ecology, University of Szeged, H-6726 Szeged, Közép fasor 52., E-mail: martonjudit1982@gmail.com

Introduction

The backwater Gyálai-Holt-Tisza was created at the 19th century as the 90th cut-off of the Tisza. Its length is 18,7 km, and average width is 86 m. It is divided into three sections by dams and sluices (Pálfai 2003).

The water quality is changing from the southern to the northern pool, the northern one is the most polluted. Thus, the utilization of the pools is different. The lower pool is a fishing area, the middle one is used for angling, and both provide water for irrigation.

The upper part is separated by “Hattyasi átjáró” and used for storing waters. It gets water from run-off from the city of Szeged, some sewage-water and has a run-off of thermal waters, which causes heat- and salt-load to the pool. From 2001, the construction of a sewage system results no more diffuse pollution to the section, though household sewage still gets into it.

The rotifer fauna of the upper section is almost unknown. In an investigation in 2000–2001 (Rédei 2002) rotifers were found in lesser species and individual numbers than the in the neighbouring parts. The fauna of the part near the sewage system was not investigated before.

Material and methods

Samples were collected with a 10 litre plastic container from the surface and filtered with a net with a mash size of 40 µm, at five points of the backwater: four of them were in „Fekete-víz” (Pool 3) (sampling sites 2, 3, 4 and 5) and one at the control area of „Fehér-part” (Pool 2) (sampling site 1) (Fig. 1). Geographical coordinates of the sampling sites are listed in Table 1.

Table 1: Geographical coordinates of the sampling sites

Sampling site code	Locality	
1	46°13’35.8”	20°05’48.9”
2	46°13’41.2”	20°05’59.8”
3	46°13’42.1”	20°06’10.5”
4	46°13’37.3”	20°06’44.1”
5	46°13’04.0”	20°07’04.1”

Sampling periods took place 4 times in 2005. The first period was between 6. April and 4. May (average gap of 2 days between sampling dates), the second one between 25. June and 8. July (daily sampling), the third one between 15–27. August (daily), and the last one between 29. September and 12. October (daily). The samples were fixed with 35% formol solution.

Three samples were collected at one time in each sampling site.

The following parameters were measured during the sampling: pH and water temperature with Milwaukee SM 102 digital device, conductivity with Milwaukee SM 302 (0–10 µS) and transparency with a Secchi-disk.

The conductivity (G) data, to be comparable, must be standardized to a constant temperature (20 °C) with an

$$f_t = \frac{1}{1 + 0.023 \times (t - 20)}$$

component, where t is temperature. The standardized data can be conversed into whole ion content, as

$$\textit{whole ion}\ [\mathrm{g/m^3}] = 0.63 \times G_{20}\ [\mu\mathrm{S/cm}]$$

(Németh 1998).

Samples were filtered to a 10–70 cm^3 final volume, depending on the density. Individuals of taxa in a known volume were counted, at least 100 individuals per sample. In some cases dilution was needed. The final number was transformed into individuals per litre.

The statistical analysis was performed with the programme „Palaeontological Statistics” (PAST) (Hammer *et al.* 2001).

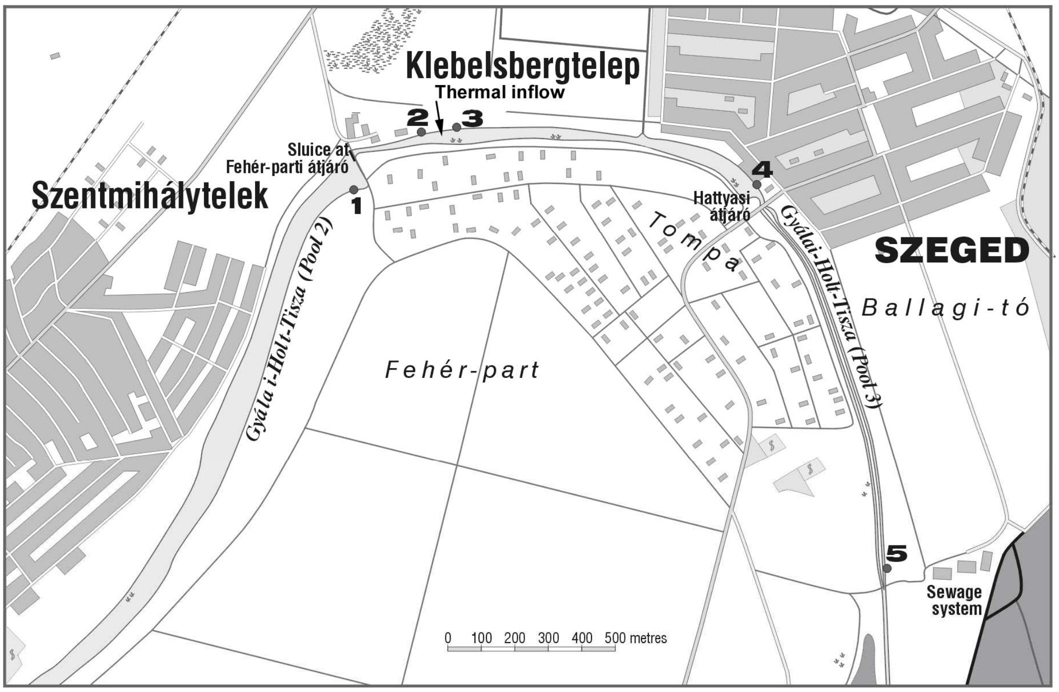

Fig. 1. The sampling sites at „Gyálai-Holt-Tisza”

Results

Thirty-one taxa of Rotatoria were identified: 20 of them are species, 10 genera and 1 class (Bdelloidea, the individuals were unable to be identified after fixation).

Water parameters changed daily and seasonally. The most constant values were measured at sampling sites 1 and 5, though there was fluctuation at them according to the weather conditions.

Water temperature was the lowest at sites 1 and 5, and, according to the thermal inflow and the dark colour of the water body, at sites 2–4 higher temperatures were detected.

The pH was alkalic (7,9–9,3) in the whole year, there was a gradient-like spatial decrease in its values from sampling sites 1 to 5.

The whole ion content was the lowest at site 1 and the highest at sites 3–4, and a medium value was calculated for site 5.

There was no tendency of significant correlation between the daily average data of water parameters and the individual number of the most dominant rotifer species.

The seasonal average individual number of every sampling place was transformed to percent values. Principal component analysis (PCA) was made on those relative abundance values.

PCA analysis showed seasonality, as the seasonal polygons do not overlap (Fig. 2.), while the sampling sites do not separate from each other, as the sampling sites' polygons overlap in four cases (sampling sites 1–4) with the exception of site 5 (Fig. 3.).

Daily Rotatoria individual numbers of sites 2–5 were compared to those of site 1, in connection with the opening and closing events of the sluice at „Fehér-parti átjáró". During the open periods rotifers appeared in the samples in very high numbers at „Fekete-víz" compared to the closed periods. After closing the sluice the individual number decreased fast to a smaller level. The difference was often at the 10^5 times level. With the distance from the sluice, some delay occurred in detecting the peak number of rotifers. At site 2, the peak number appeared right the day of the opening, at site 3 on the day of the opening, or one day later, at point 4 two or three days delay was detected. Site 5 was too far from the sluice or the two weeks period was not enough to see a connection.

During the sampling period in October the sluice was not opened, thermal water flew in and almost no rotifers were found in the samples of sites 3 and 4, and only few species occurred at site 2. At sites 1 and 5 several species appeared, and different fauna was found in the two places.

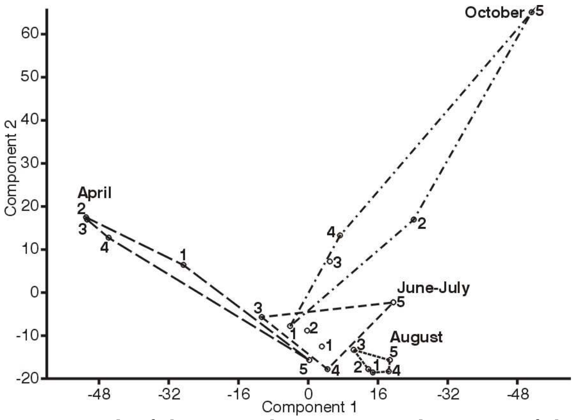

Fig. 2. Result of the principal component analysis. Dots of the same period are connected.

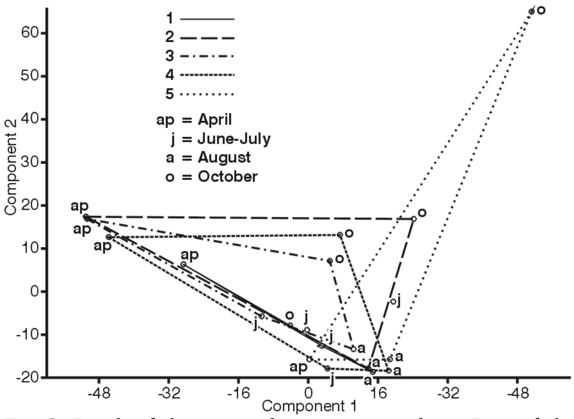

Fig. 3. Result of the principal component analysis. Dots of the same sampling site are connected.

Discussion

The investigated pool was dominated by eutrophic, cosmopolite, planktonic species that tolerate more or less the salt load of the thermal flow.

The lack of macrovegetation predicts less diverse fauna. Pelagic environments are dominated by *Keratella*, *Brachionus*, *Hexarthra* and *Polyarthra* species, while on eutrophic waters *Trichocerca* and *Filinia* species are common (Castro *et al.* 2005).

At a former investigation in 1950–1951 (Székelyné 1954) 66 species and 14 varieties were found. Various places were sampled: coastal area, open water, among the vegetation, sediment and tekton, though the exact place is not known, the description suggests that at Pool 3, between the sluice and "Hattyasi átjáró". Constant and high level of plankton species was detected. The relation of the species differed from that of nowadays: the former most common species, *Testudinella* and *Lepadella* decreased, while *Brachionus* species became more usual by this time.

In 2000–2001, Rédei (2002) found only 11 species in this pool, most of them were *Brachionus* species. He investigated the neighbourhood of the sluice.

The difference in the rotifer fauna between these two investigations show a radical change in the water quality. From 1962, the pool served as sewage container, and the pumping station of Hattyas („Hattyasi szivattyútelep") pumped the sewage water to the Tisza. The mud of the sewage added much to the decrease of the water quality (Jusztinné 2001).

With the load of organic materials, bacteria proliferate, they use the oxygen of the water body, and other organisms die out. Anaerobic bacteria and organisms that tolerate the lack of oxygen appear in large numbers (Felföldy 1981).

Though an influence of the weather was detected, the parameters of the water were more constant at site 1, than those of at the four other sites, where the most important influencing factors were thermal, salty inflowing water, mainly in spring and autumn, and the easily changing parameters caused by the shallowness. After opening the sluice, conditions became more similar in the two pools, except site 5, which was too far from the sluice.

Though many investigations showed that pH, water temperature, conductivity and transparency have a great influence on the composition and density of zooplankton (Spoljar *et al.* 2005 and Devetter 1998), they could not modify the fauna here. An important, but not measured factor must be dissolved oxygen level. Balázs (2003) could detect near 0 level of dissolved oxygen even in laboratory, and none at the surface water in the field at Pool 3, on the other hand laboratory measurement showed about 100 times higher level of oxygen at the water of „Fehér-part".

It was raining many times in 2005, which caused frequent openings and closings of the sluice. According to the flow, there might have been a higher level of dissolved oxygen, which could have helped the rotifers to survive longer and in higher numbers in individuals than during the year of the former investigation.

Seasonality was pointed out, but the sampling points did not differ much from each other during a sampling season. The exception was October, when the sluice was not opened, rotifers did not flow into the pool, and according to the conditions: possibly the lack of oxygen, or the higher salt concentration – above 2–3 g/l NaCl concentration rotifers are unable to reproduce (Sarma *et al.* 2006) – there were almost no rotifers in the samples. At the other end of the pool, water was clearer, and the fauna consisted of several very abundant species, and some less abundant species that were found only at site 5.

These prove that the pool between the „Fehér-parti átjáró" and the „Hattyasi átjáró" has no constant rotifer fauna. Most (or maybe all) individuals come from the neighbouring pool after opening the sluice. After the flow is interrupted, rotifer level decreases due to oxygen-lack, some toxic substances or invertebrate predators (Williamson 1983).

References

Balázs, E. (2003): A Gyálai Holt-Tisza Fekete-part nevű szakaszának felszíni vízminősége (Surface water quality of Fekete-part, the upper pool of Gyálai-Holt-Tisza). – Technical report, Szeged, 25 pp. (in Hungarian)

Castro, B. B., Antunes, S. C., Pereira, R., Soares, A. M. V. M., Goncalves, F. (2005): Rotifer community structure in three shallow lakes: seasonal fluctuations and explanatory factors. – Hydrobiologia 543, 221-232.

Devetter, M. (1998): Influence of environmental factors on the rotifer assemblage in an artificial lake. – Hydrobiologia 387/388, 171-178.

Felföldy, L. (1981): A vizek környezettana. Általános hidrobiológia (Watery environmental studies – General hydrobiology). – Mezőgazdasági Könyvkiadó Vállalat, Szeged, 291 pp. (in Hungarian)

Hammer, O., Harper, D. A. T. and Ryan, P. D. (2001): PAST: Palaeontological Statistics software package for education and data analysis. – Palaeontologia Electronica 4, 9 pp.

Jusztinné, N. A. (2001): A Gyálai Holt-Tisza helyzete és rehabilitációjának célkitűzései (Condition of Gyálai Holt-Tisza and aims of its rehabilitation). – Dissertation, Szeged, 67 pp. (in Hungarian)

Németh, J. (1998): A biológiai vízminősítés módszerei (Methods in biological water qualification). – Vízi Természet- és Környezetvédelem 7, 303 pp. (in Hungarian)

Pálfai, I. (2003): Oxbow-lakes in Hungary. – Ministry of Environmental Control and Water Management, Budapest. 125 pp.

Rédei, K. K. (2002): A Gyálai Holt-Tisza planktonikus Rotatoria faunájának kvalitatív és kvantitatív vizsgálata (Qualitative and quantitative investigation of the planktonic Rotatoria fauna of Gyálai-Holt-Tisza). – Dissertation, Szeged, 60 pp. (in Hungarian)

Sarma, S. S. S., Nandini, S., Morales-Ventura, J., Delgado-Martinez, I. and Gonzalez-Valverde, L. (2006): Effects of NaCl salinity on the dynamics of freshwater zooplankton (rotifers and cladocerans). – Aquat. Ecol. 40, 349-360.

Spoljar M., Habdija I., Primc-Habdija B. and Sipos, L. (2005): Impact of environmental variables and food availability on rotifer assemblage in the karstic barrage Lake Visovac (Krka River, Croatia). – International Review of Hydrobiology 90, 555-579.

Székely Lajosné (1954): A szegedi Holt-Tisza kerekesférgei (Rotatoria) (Rotifers of the Holt-Tisza at Szeged). – A magyar tudományegyetemek biológiai intézeteinek évkönyve, 1952, 479-490. – Tankönyvkiadó Vállalat, Budapest (in Hungarian)

Williamson, C. E. (1983): Invertebrate predation on planktonic rotifers. – Hydrobiologia 104, 385-396.