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Original research paper

Preliminary investigations of psammon rotifers in two reservoirs in Upper Silesia[1]

Irena Bielańska-Grajner[2]

Department of Ecology, University of Silesia
ul. Bankowa 9, 40-007 Katowice, Poland

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Abstract

Psammon rotifers were investigated in two lakes of different trophy and degrees of pollution. The Pławniowice Duże Reservoir is mesotrophic, while the Dzierżno Duże Reservoir is highly eutrophic and polluted. Samples were collected from three zones on sandy beaches - one meter above the shoreline (eupsammon), at the shoreline (hygropsammon) and below the water level (hydropsammon).

A larger number of rotifer species (28) was detected in the Pławniowice Duże Reservoir than in the Dzierżno Duże Reservoir (18). The species structure of the rotifer communities differed in the two reservoirs. While the density of eupsammic rotifers observed in both reservoirs was high, significant differences were noted in the abundance of them. The dominant species were *Cephalodella gibba, Cephalodella catellina* and *Lecane closterocerca.*

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[2] *igrajner@us.edu.pl*

INTRODUCTION

Psammon rotifers have been studied on the sandy beaches of lakes (Wiszniewski 1934 a, 1934 b, 1937, Myers 1936, Pennak 1940, Ruttner-Kolisko 1953, Neel 1948, Evans 1984 Ejsmont-Karabin 1998, 2003, Bielańska-Grajner 2001, Radwan and Bielańska-Grajner 2001), as well as on the beaches of rivers and streams where the abundance of rotifers species is higher (Neiswestnowa-Shadina 1935, Evans 1984, Turner and Distler 1995, Turner 1996, Schmid-Araya 1998, Ricci and Balsamo 2000).

Pennak (1951) maintained that rotifer occurrence can be extremely abundant on lake beaches. Approximately 40 species (taxa) of rotifers occur in this environment. Wiszniewski (1937) identified the following structural groups of lake psammon rotifers: psammobionts - species occurring only in sand and rare in other habitats; psammophilic - species occurring in sand, periphyton and open waters; psammoxenic – rotifers that are accidental in sands.

To date, no studies have been conducted on the psammic rotifers in the beaches of man-made reservoirs, including dam reservoirs. This was the impetus for undertaking the current studies on psammic rotifers in the beaches of dams situated in Upper Silesia.

MATERIALS AND METHODS

The rotifers were collected during spring, summer and autumn 2001 from sites at the Pławniowice Duże Dam Reservoir and in summer and autumn 2001 from those at the Dzierżno Duże Reservoir. The collection methods were based on those described by Evans (1984) and Wiszniewski (1934b). Psammon samples were collected from three zones: euarenal – from the beach 1 m above the water line; hygroarenal – at the edge of the zone wetted by lake waves; hydroarenal – from the lake bottom 1 m below the water line. All of the samples were collected with a plastic corer 3.5 cm in diameter and 10 cm in length. Only two fractions, 0-1 cm and 1-2 cm sample depth, were analyzed. Ten samples were collected at each site, five each for qualitative and quantitative analysis. The quantitative samples were preserved in a mixture of formaldehyde and glycerol (ratio 3:1). The qualitative analysis was conducted on live rotifer species.

The dam reservoir in Pławniowice Duże was created in 1974 by flooding the sand excavation site with a stream. This basin is a lowland dam reservoir, but its shape is not typical. It has a flattened bottom and a long water exchange period (about 2 years), which means that this reservoir also has some properties of a natural lake. It can be classified as an extremely limnic reservoir. It has a surface area of 250 ha and a maximum depth of 15 m.

Dzierżno Duże was created in 1964 in the same manner, i.e., a sand excavation site was flooded with waters from the Kłodnica River, which was contaminated with industrial and municipal sewage and slime coal. This reservoir works as a sediment trap for the Kłodnica River. Dzierżno Duże has a surface area of 620 ha and a maximum depth of 20 m.

These results show that, in comparison with lake water, the interstitial water had a very low oxygen content, pH was lower and the content of phosphorous was higher (Table 1).

Table 1

Physical and chemical parameters of the reservoir water and the interstitial water on the beaches.

Reservoirs	Zone	Temp. (°C)	pH	O_2 (mg dm^{-3})	PO_4 (mg dm^{-3})	NO_3 (mg dm^{-3})
Pławniowice Duże	hydroarenal	18 - 27	9.0	3 - 7.1	0 - 0.25	0 - 5
	euarenal	20 - 24	7.0 - 8.5	2.2 - 4.0	0.25	0
Dzierżno Duże	hydroarenal	16 - 21	7.5 - 8.0	5 – 7.1	2 - 2.5	0 - 5
	euarenal	17 - 23	7.5	4 - 4.5	>3	0

RESULTS AND DISCUSSION

A total of 30 taxa were noted in the reservoirs, with 26 in Pławniowice Duże and 17 in Dzierżno Duże (Table 2). The rotifers were classified according to ecological groups - psammobionts, psammophiles, psammoxens (Table 2). In Pławniowice Duże there were two species of psammobionts - *Lecane psammophila* and *Trichocerca taurocephala*, 14 species of psammophiles and ten of psammoxens. In Dzierżno Duże only one species, *Trichocerca taurocephala*, was classified as a psammobiont, 12 species were classified as psammophiles and four as psammoxens.

The results differed from those obtained in some natural lakes where many more species of psammon rotifers were noted. Wiszniewski (1932) found 82 species in Lake Wigry, Myers (1936) noted 145 species in lakes Lanape and

Table 2

Alphabetical list of rotifers noted in the psammon of the investigated reservoirs. Ecological Species Type (EST): Pb − psammobiont, Pph − psammophil, Px − psammoxen.

Taxa	Pławniowice D.	Dzierżno D.	EST
Adineta vaga (Davis)		+	Pph
Cephalodella auriculata (Műll.)	+		Pph
Cephalodella catellina (Műll.)	+	+	Pph
Cephalodella catellina (Műll.) ♂		+	
Cephalodella gibba (Ehrb.)	+	+	Pph
Cephalodella gibba (Ehrb.) ♂	+		
Cephalodella gracilis (Ehrb.)	+	+	Pph
Cephalodella ventripes (Dix.-Nutt.)	+	+	Pph
Cephalodella sterea (Gosse)	+		Px
Colurella adriatica Ehrb.	+		Px
Colurella colurus (Ehrb.)	+	+	Pph
Colurella hindenburgi Stein.	+		Px
Dicranophorus pronacis Harr. et Myers	+		Px
Encentrum arvicola Wulfert		+	Pph
Encentrum marinum (Dujard.)			Px
Lecane closterocerca (Schm.)	+	+	Pph
Lecane levistyla (Olof.) ♂	+		Pph
Lecane luna (Műll.)	+	+	Px
Lecane lunaris (Ehrb.)	+		Pph
Lecane psammophila Wiszn.	+	+	Pb
Lecane scutata Harr. et Myers	+	+	Pph
Lepadella patella (Műll.)	+	+	Pph
Lepadella patella (Műll.) ♂	+		
Lindia pallida Harr. et Myers	+		Pph
Notommata cyrtopus Gosse	+	+	Px
Philodina acuticornis Wulfert	+	+	Px
Rotaria tridens (Montet)	+		Px
Trichocerca iernis (Gosse)		+	Px
Trichocerca intermedia Sten.	+		Pph
Trichocerca insignis (Herrick)	+		Px
Trichocerca taurocephala Hauer	+		Pb
Trichocerca tenuior (Gosse)	+		Pph
Trichocerca uncinata (Voigt)	+	+	Pph
Trichocerca weberi (Jenn.)	+	+	Px

Union (USA) and Neel (1948) identified 38 species in Lake Douglas (USA). However, Ejsmont-Karabin (2003) observed from 20 to 48 species of psammon rotifers in lakes with different trophic states, but only five species in the hypertrophic Lake Kocioł. In their work on the Włodawsko-Łęczyńskie Lakeland, Radwan et al. (2003) observed more psammon rotifer species in mesotrophic lakes (32) than in eutrophic and hypertrophic lakes (9 - 23 species). According to Schmid-Araya (1998), the most rotifer taxa are observed in flowing water, rivers and streams.

The contribution of psammobiont species in natural lakes (Bielańska-Grajner 2001, Radwan, Bielańska-Grajner 2001, Ejsmont-Karabin 2003) and rivers (Turner and Distler 1995) is much higher than it was in the studied reservoirs.

The two reservoirs differed in both psammon rotifer community structure and rotifer abundance. In both reservoirs the highest number of rotifers was found in the eupsammon, while the lowest number was noted in the hydropsammon (Figures 1, 2).

The highest number of psammon rotifers was observed in Dzierżno Duże (41 236 ind./dcm^3 sand) in summer, while in Pławniowice Duże more were observed in fall. Hydroarenal rotifers were not observed in the bottom surface of the sand in Pławniowice Duże reservoir in summer and fall or in Dzierżno Duże in summer (Figures 1, 2).

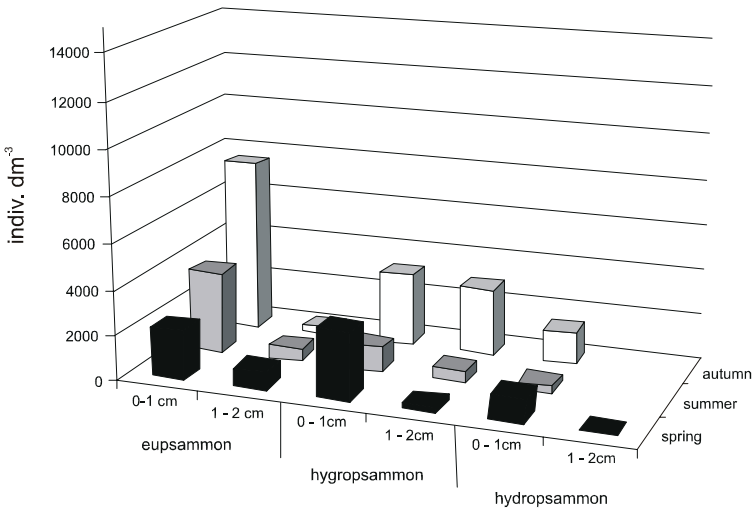

Fig. 1. Distribution of psammon rotifers in Pławniowice Duże Dam Reservoir (mean abundance by seasons and zones).

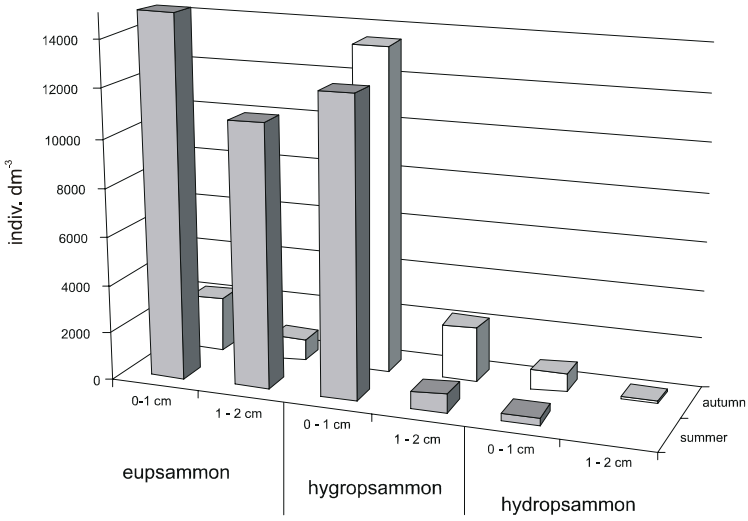

Fig. 2 Distribution of psammon rotifers in Dzierżno Duże Dam Reservoir (mean abundance by seasons and zones).

The rotifer community structure of dominants in Pławniowice Duże was balanced, with three dominant species - *Cephalodella gibba, Lecane closterocerca, Cephalodella catellina*, and ten subdominant species - *Lecane psammophyla, Philodina acuticornis, Lepadella patella, Trichocerca tenuior, Lecane levistyla, Trichocerca taurocephala, Lecane scutata, Colurella colurus, Cephalodella ventripes, Cephalodella auriculata* (Fig. 3.). The remaining taxa were recedents.

The rotifer community structure of dominants in Dzierżno Duże was unbalanced. One superdominant species, *Cephalodella catellina*, occurred. There were three species of subdominants - *Cephalodella gracilis*, *Lecane closterocerca* and *Encentrum arvicola* (Fig. 4), and the remainders were recedents.

The rotifer community structure of dominants in the Pławniowice Duże Reservoir was similar to that observed in the natural lakes of the Great Masurian lakes (Ejsmont-Karabin 2003) and the Bytowskie lakes (Bielańska-Grajner 2001). However, it differed completely in Dzierżno Duże.

The Shannon-Weaver diversity index indicated that the community structure in both lakes studied was different. In the Pławniowice Duże Dam reservoir, the highest diversity index value was observed in the hydropsammon (2.47), with lower values in the eupsammon (2.02) and hygropsammon (1.84). In Dzierżno Duże Reservoir, the diversity index was very low in the

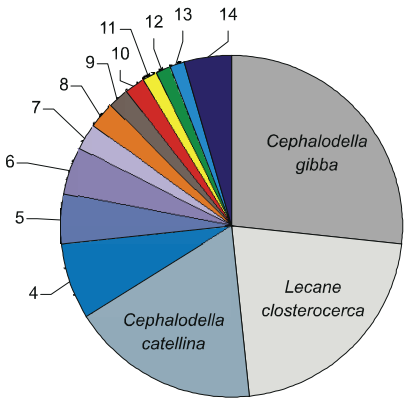

Fig. 3. Percentage of dominant species from the total abundance of psammon in Pławniowice Duże (mean value of three zones): 4-*Lecane psammophyla,* 5 - *Philodina acuticornis,* 6 - *Lepadella patella*, 7 - *Trichocerca tenuior,* 8 - *Lecane levistyla,* 9 - *Trichocerca taurocephala,* 10 - *Lecane scutata,* 11 - *Colurella colurus*, 12 - *Cephalodella ventripes,* 13 - *Cephalodella auriculata,* 14 – others

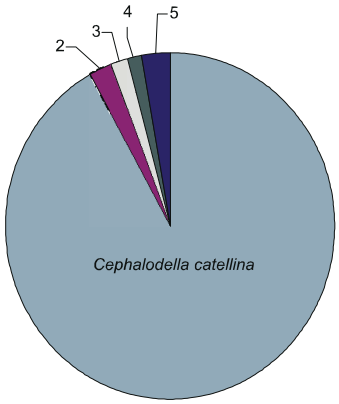

Fig. 4. Percentage of dominant species from the total abundance of psammon in Dzierżno Duże (mean value of three zones): 2 - *Cephalodella gracilis,* 3 - *Lecane closterocerca,* 4 - *Encentrum arvicola, 5*- others.

hydropsammon (1.79), and even lower in the hygropsammon (0.45) and eupsammon (0.41).

In conclusion, the psammon rotifer communities in the two dam reservoirs in Upper Silesia had their own particular structure. The community structure of psammon rotifers in Pławniowice Duże Reservoir was similar to that in eutrophic and hypertrophic natural lakes, while that in Dzierżno Duże Reservoir varied completely from the structure of psammon rotifers identified in other Polish lakes.

SUMMARY

The psammon rotifers in two dam reservoirs in Upper Silesia were studied. The quantitative and qualitative structures of the rotifers that inhibited the studied lakes were analyzed. There were more species in the Pławniowice Dam, but the number of rotifers was lower, and the community structure of dominants was balanced. In Dzierżno Duże, the number of rotifers species was lower, but the abundance of rotifers was higher and the structure of the rotifer community was unbalanced. The communities of psammon rotifers in Dzierżno Duże Reservoir differed from descriptions of those in natural

lakes, while the community of psammon rotifers in Pławniowice Duże Reservoir was similar to those found in eutrophic and hypertrophic lakes.

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