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Meiobenthic assemblages, particularly Copepoda-Cyclopoida
in the Czorsztyński and Sromowiecki reservoirs
(the Pieniny Mountains, Poland)

Zgrupowania meiobentosu, ze szczególnym uwzględnieniem Copepoda-Cyclopoida
zbiorników Czorsztyńskiego i Sromowieckiego (Pieniny, Polska)

SUMMARY

There are located two reservoir dams: Czorsztyński and Sromowiecki between Dąbki and Sromowce Niżne. They were created in the 90's of the 20th century as a result of construction of a water power station in Niedzica. The purpose of this research was to determine the scale of the diversification of meiobenthos inhabiting littoral. It was based on the analysis of the higher rank taxons as well as on the analysis of the group of Copepoda-Cyclopoida. The research was carried out on the samples collected in July 2007. In the analysed material, there were observed 11 systematic groups characteristic of meiobenthos. The lowest density of meiobenthos was on the stations placed in the Czorsztyński reservoir, near the dam, where the base was formed from limestones and lots of sedimentary mud. In the analysis 12 species of Cyclopoida were recorded, the 11 species that were found are new for the fauna of the Pieniny Mts.

STRESZCZENIE

Pomiędzy Dąbkami a Sromowcami Niżnymi znajdują się obecnie dwa zbiorniki zaporowe: Czorsztyński i Sromowiecki powstałe w latach 90. XX wieku w wyniku budowy elektrowni wodnej w Niedzicy. Celem prezentowanej pracy jest określenie stopnia zróżnicowania meiobentosu

zasiedlającego litoral na podstawie analizy wyższych rangą taksonów, a także analiza gatunkowa zgrupowania Copepoda-Cyclopoida. Badania przeprowadzono na podstawie materiałów zebranych w lipcu 2007 roku. W badanym materiale stwierdzono obecność 11 charakterystycznych dla meiobentosu grup systematycznych. Zagęszczenie meiobentosu było najmniejsze na stanowiskach położonych w Zbiorniku Czorsztyńskim w pobliżu zapory, gdzie podłoże stanowiły skały wapienne z dużą ilością osadów mulistych. W badanym materiale oznaczono 12 gatunków Cyclopoida, z których 11 jest nowych dla fauny Pienin.

Key words: Pieniny, dam reservoirs, meiobenthos, Cyclopoida, new records

INTRODUCTION

In the former gorge of the Dunajec river, between Dąbki and Sromowce Niżne there are located two reservoir dams: Czorsztyński and Sromowiecki. They were created in the 90's of the 20th century as a result of construction of a water power station in Niedzica. In 1994 the reservoir Sromowce Wyżne was created and in 1997 all the structures were given into use (<http://www.zzw-niedzica.com.pl/historia.htm>).

There has not been examined the state of colonization. Both dams have not been examined in order to find meiobenthos and to describe the state of its colonisation. Furthermore, meiobenthos inhabiting Dunajec, as well as streams and wells in the area were not examined. The aim of the research is to estimate meiobenthic assemblages of littoral zone of dam reservoirs.

There is insufficient research on the specific systematic groups of water invertebrate inhabiting Pieniński Park Narodowy (the Pieniński National Park) (e.g. Razowski 2000, Dratnal et al. 1979, Szczęsny 1995, Witkowski 2003).

Small meiobenthic invertebrates remain on sieve on mesh 0.042 mm and rinsed on sieve on mesh 1.0 mm Pfannkuche, Thiel 1988), are sensitive indicators of changes appearing in the environment. Nowadays, more and more species belonging to this group are classified as the bioindicators (Mezquita et al. 1999, Walker et al. 2002, Martins et al. 2007). Furthermore, meiobenthos is not an unreal group which is based on the size of the organisms. Meiobenthos form the group which possesses its own functional structure and which is very useful when serves as an indicator in the environmental quality research (Warwick 1990, Särkkä 1992, Reis, Schmid-Araya 2008).

The purpose of this study was to determine the range of the diversification of meiobenthos inhabiting littoral. It was based on the analysis of the higher rank taxa, as well as on the analysis of the group of Copepoda-Cyclopoida. The research was carried out on the samples collected in July 2007. Conservation work on the turbine of the water power station at the turn of 2007/2008 was related to a long-term decrease of the water level of over a dozen metres. Due to this fact the data collected in the research are of the unique value.

RESEARCH AREA

Nowadays, dam reservoirs of the Pieniny Mts – Czorsztyński and Sromowiecki, partly occupy the area of the Pieniński National Park. Reservoirs are located on a different geological base that is – in a vast part – composed of limestones (Birkenmajer 1992, 1999, 2006). The Czorsztyński reservoir, near Dębki, has an artificial, strengthened shore, the rest of the shores (except for the lands surrounding the dam) have natural limestone walls. The Sromowiecki reservoir's shores have revetments made of stones and gauze.

MATERIAL AND METHODS

Samples for this study were collected in summer seasons of 2007 (15.07–19.07.2007) from 11 various sites (Fig.1).

Samples for this study were collected from the littoral zone of 20–30 cm depth. Quantitative samples were collected with a core with a diameter of 2.5 cm from the surface layer of bottom sediment to the depth of 10 cm. Qualitative samples were collected by a hand net with a mesh of 42 μm (volume of a one sample was about 0.5 l. Measurements of basic hydrological parameters (temperature, pH, salinity, conductivity) were taken concurrently with collecting the biological samples.

On the basis of quantitative tests, the density of meiobenthos N_{10} (amount of specimens / 10 cm^2) was evaluated. In the analyzed material, characteristic taxa for the group were assayed, however of different systematic positions. Zoocenological analyses were carried out, these were: frequency was calculated (Fr) commonness of occurrence expressed as $\text{Fr} = N_i/N$, where N_i – a number of points in which a given species was found, N – amount of all the points; relative number (Dm) expressed as a percentage share of the amount of specimens of the taxa in relation to the amount of all the specimens on the given point or in the material from a series of tests; domination indicator, while the following division in terms of percentage share in the group was accepted: dominants [$D > 50\%$], sub-dominants [$25\% < sD \leq 50\%$], influents [$10\% < I \leq 25\%$], sub-influents [$3\% < sI \leq 10\%$], recedents [$1\% < R \leq 3\%$], sub-recedents [$sR \leq 1\%$] (Wojtasik 2007).

Mature females of Cyclopoida were identified to the species using publications by Rylov (1948), Dussart (1969) as well as Rybak and Błędzki (2005). Nomenclature was given in consistency with the work of Rybak and Błędzki (2005).

RESULTS AND DISCUSSION

There is some influence of variable geological base on the sediment bottom of the examined reservoirs, especially Czorsztyński. Semimetal mud, mud-sands and mud-gravel (near Niedzica and Czorsztyn, bays of the Czorsztyński reservoir and station in the Sromowiecki reservoir) were the most common types of sediment bottom in littoral. Stone-gravel-mud sediments were characteristic of the stations located in bay mouth and along the shore line (except parts of bays from Czorsztyn to Nowe Maniowy).

The analyses of hydrological conditions of the studied reservoirs indicated pH ranging from 8.58 to 9.04, temperature ranging from 22.5 to 27.0°C, conductivity from 221 to 265 $\mu\text{S}/\text{cm}$.

In the analysed material, there were observed 11 systematic groups characteristic of meiobenthos (Table 1). Collembola has been found as well, however because of the low value of $N_{10} < 1$, the group was not included in the present analysis. Also in the samples from the Czorsztyński reservoir a single representative of Hydroidea was collected. There were no young forms of Mollusca found, though they are numerous in the profundal (Wojtasik, own results).

A great taxonomic variety in relation to meiobenthos settled in the littorals of the Czorsztyński and Sromowiecki reservoirs between the heterogeneity and the

Tab.1. Relative abundance (Dm) and frequency of occurrence (Fr) of taxa found in the samples analysed, Dm(t) – relative abundance in all samples

Station	Relative abundance (Dm [%]) of major meiobenthic taxa											N ₁₀
	Turbellaria	Gastrotricha	Rotifera	Nematoda	Oligochaeta	Cladocera	Copepoda	Ostracoda	Diptera larvae	Acarina	Tardigrada	
A	0.0	0.0	4.2	83.3	0.0	0.0	0.0	0.0	4.2	0.0	8.3	48
B	0.0	0.0	11.1	66.7	0.0	22.2	0.0	0.0	0.0	0.0	0.0	36
C	1.1	0.0	46.2	11.0	1.1	2.2	35.1	1.1	1.1	1.1	0.0	182
D	0.0	0.0	0.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	4
E	9.1	0.0	0.0	45.4	0.0	27.3	9.1	0.0	9.1	0.0	0.0	22
F	0.0	0.0	30.0	40.0	10.0	0.0	10.0	10.0	0.0	0.0	0.0	20
G	16.7	0.0	16.7	16.7	0.0	0.0	16.7	0.0	0.0	33.2	0.0	12
H	25.0	0.0	16.7	25.0	8.3	0.0	16.7	0.0	0.0	8.3	0.0	24
I	0.0	0.0	33.(3)	33.(3)	0.0	0.0	0.0	0.0	33.(3)	0.0	0.0	6
J	7.1	0.0	28.7	7.1	7.1	0.0	35.8	7.1	0.0	0.0	7.1	28
K	28.1	3.1	21.9	21.9	0.0	3.1	6.3	3.1	9.4	0.0	3.1	64
Dm(t)	7.2	0.4	28.3	29.1	1.8	4.5	20.2	1.8	3.1	1.8	1.8	
Fr	0.55	0.09	0.82	1.0	0.36	0.36	0.73	0.36	0.45	0.27	0.27	

Tab. 2. Occurrence (+) and frequency of occurrence (Fr) of Cyclopoida species found in the samples analysed

Species of Cyclopoida	Station											Fr
	A	B	C	D	E	F	G	H	I	J	K	
<i>Acanthocyclops venustus</i> (Norman et Scott, 1906)							+					0.09
<i>Diacyclops</i> sp. (Lilljeborg, 1901)								+				0.09
<i>Diacyclops nanus</i> (Sars, 1863)			+						+			0.18
<i>Mesocyclops bodanicola</i> (Kiefer, 1929)									+			0.09
<i>Mesocyclops leucarti</i> (Claus, 1857)		+	+	+	+	+	+		+	+	+	0.82
<i>Metacyclops gracilis</i> (Lilljeborg, 1853)					+							0.09
<i>Microcyclops varicans</i> (Sars, 1863)										+	+	0.18
<i>Paracyclops affinis</i> (Sars, 1863)						+				+	+	0.27
<i>Paracyclops fimbriatus</i> (Fischer, 1853)	+	+	+	+		+	+		+	+	+	0.82
<i>Paracyclops poppei</i> (Rehberg, 1880)											+	0.09
<i>Thermocyclops crassus</i> (Fischer, 1853)				+	+	+			+		+	0.45
<i>Thermocyclops dybowski</i> (Landé, 1890)		+			+							0.18
<i>Thermocyclops oithonoides</i> (Sars, 1863)											+	0.09

density of population was discovered. The lowest density of meiobenthos was observed in the Czorsztyński reservoir sample sites, near the dam, where the base was formed of white rocks and lots of sedimentary mud. The uneven settlement of littoral in the nearby stations can show a process of inhabiting and forming of local meiobenthic assemblages. A higher value of N_{10} was obtained for stations located in the Sromowiecki reservoir. The highest attendance and abundance of Nematoda, Rotifera, and Copepoda was found. The other of major systematic groups belonged to subinfluent, recedents or/and subrecedents.

The comparison of the results of research on meiobenthos with the previous research from the Pieniński National Park shall be carried out individually for certain systematic groups, because the bibliography data usually refer to selected thus and allow a more detailed comparison of Oligochaeta (Dratnal et al. 1979, Szczęsny 1995), Copepoda and Ostracoda (Sywula, Jędryczkowski 2000), Diptera and Ephemeroptera (Dratnal et al. 1979, Szczęsny 1995). Furthermore, it also enables the analysis of the changes of threatened species occurrence (Witkowski 2003). In this contribution special attention is focused on Copepoda-Cyclopoida.

In the analysis 12 species of Cyclopoida were identified (Table 2). The previous data referring to the Pieniny area, mention 7 species of Cyclopoida (Sywula, Jędryczkowski 2000) among which we found only *Paracyclops fimbriatus* at the majority of research stations. The other 11 species that were found are new for the Pieniny Mts fauna. The taxonomically richest was Cyclopoida group, found on a station in Sromowiecki reservoir, which can be caused by smaller fluctuations of water level than those appearing in the Czorsztyński reservoir.

Obtained results, especially about species of Cyclopoida (new for the Pieniny Mts.), indicate changes in the meiofauna of this region. These changes occur as a result of the existence of the reservoir dams.

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