MACROBENTHOS DIFFERENTIATION AMONG OX-BOW LAKES OF THE RIVER BUG WITHIN THE BUG RIVER VALLEY LANDSCAPE PARK

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Summary. Macrobenthos was studied in six ox-bow lakes of varied hydrological regimes – from lakes connected with the river to ones totally isolated from the mainstream. From 22 to 30 invertebrate taxa belonging to five classes: Hirudinea, Malacostraca, Insecta, Gastropoda and Bivalvia were found in studied lakes. Molluscs had a great share (91-99%) in the biomass of macrobenthos. Oxbow lakes directly connected with the river were particularly rich in bivalves of the family Unionidae, in *Dreissena polymorpha*, and in snails of the family Viviparidae. Densities of these molluscs sometimes reached several hundred individuals per m² and their fresh biomass with shells – up to 6.5 kg per m². Ox-bow lakes connected with the river mainstream showed greater species diversity of macrobenthos as compared with those long ago and permanently cut-off from the river.

Key words: the Bug River Valley Landscape Park, ox-bow lakes, benthos, molluscs

INTRODUCTION

The Bug River Valley Landscape Park – one of the largest landscape parks in Poland – covers the lower stretch of the Bug valley. Preserved in its natural status, the Bug valley, with meandering river and numerous ox-bow lakes, is the greatest value of the park. Ox-bow lakes were not frequently studied though they are numerous and quite differentiated. Apart from basic biological information published in popular papers [e.g. Rąkowski *et al.* 2002, Walczak *et al.* 2001], there are no detailed data on e.g. aquatic invertebrates of those ox-bow lakes. The only exception is a paper by Lewandowski [2006] who described the occurrence of molluscs of the family Unionidae in several lakes of the Bug. Therefore, detailed hydrobiological studies (hydrochemistry, benthic macroinvertebrates) were undertaken in those habitats.

STUDY AREA, MATERIAL AND METHODS

Six ox-bow lakes situated in the Bug River Valley Landscape Park (Fig. 1, Tab. 1) were studied. They all differ in hydrological regime – from lakes flushed with river waters (Szumin, Wywłoka) to ones totally and permanently isolated from the river (other ox-bow lakes).



Fig. 1. Location of studied ox-bow lakes (1 – Szumin, 2 – Wywłoka, 3 – Bużysko, 4 – Wszebory, 5 – Przewóz Nurski, 6 – Lake Białe) Rys. 1. Lokalizacja badanych starorzeczy

Standard hydrochemical analyses involved pH, oxygen in water, N and P concentrations in water and bottom sediments and organic matter content in sediments. Benthos was sampled in the near-shore zone to a depth of 1 m with the Birge-Ekman sampler. Large bivalves and snails were collected by hand from a surface area limited by a square frame 0.5×0.5 m. Density and fresh biomass of benthos were determined.

RESULTS

Water in all of the studied ox-bow lakes was alkaline (pH 7.5-8.9). Oxygen concentrations varied seasonally and were usually several mg O_2 dm⁻³. Bużysko and Przewóz Nurski were the most eutrophic with the highest concentrations of N and P (Tab. 1).

No. Nr	Ox-bow lake Starorzecza	Area Powierz- chnia (ha)	Max. depth Głęb. maks.	N total N całk. (mg dm ⁻³)	P total P całk. (mg dm ⁻³)	Organic matter (% dry wt.) Materia organiczna (% s.m.)	$P \ (mg g dry wt.^{-1}) \ P \ (mg \cdot g s.m.^{-1})$	$N \\ (mgg dry wt^{-1}) \\ N \\ (mg \cdot g s.m.^{-1})$	
			(iii)	in water		in bottom sediments			
1	Szumin	17.0	1.5	0.43-3.97	89-229	3.33±3.48	0.13±0.14	4.74±6.08	
2	Wywłoka	23.0	3.5	0.23-3.51	26-122	1.77±1.76	0.15±0.15	4.05±3.98	
3	Bużysko	25.0	2.0	0.07-2.76	155-1517	12.77±9.91	0.32±0.24	51.34±45.31	
4	Wszebory	12.0	1.0	0.29-7.39	42-132	4.08±6.62	0.46±0.97	14.95±12.38	
5	Przewóz Nurski	23.0	5.0	0.77-31.39	102-2215	2.81±2.51	0.13±0.08	7.89±2.85	
6	Białe Lake	1.5	2.0	0.30-7.56	23-146	24.37±19.36	0.35±0.18	60.30±36.80	

Table 1. Characteristics of studied ox-bow lakes in the years 2003-2004 Tabela 1. Charakterystyka badanych starorzeczy w latach 2003-2004

Thirty five invertebrate taxa were found in the studied ox-bow lakes (Tab. 2). Hirudinea, *Asellus aquaticus*, Odonata, Trichoptera, Chironomidae, Dytyscidae, *Sialis lutaria*, Heteroptera, several species of Gastropoda, including those of the family Lymnaeidae, were found in all the ox-bow lakes.

Taxa – Taksony	1	2	3	4	5	6
Hirudinea						
Glossiphonia complanata (L.)	+	+	+	+	+	+
Haemonis sanguisuga (L.)			+			
Piscicola geometra (L.)		+	+			+
Malacostraca						
Asellus aquaticus L	+	+	+	+	+	+
Gammaridae		+	+	+	+	+
Orconectes limosus (Raf)	+				+	
Insecta						
Odonata						
Zvgontera	+	+	+	+	+	+
Anisoptera	+	+	+	+	+	+
Trichontera	+	+	+	+	+	+
Enhemerontera	+		+	+	+	
Diptera						
Culicidae	+	+	+	+		+
Chironomidae	+	+	+	+	+	+
Coleontera						
Dytiscida	+	+	+	+	+	+
Megalontera						
Sialis lutaria I	+	+	+	+	+	+
Heterontera						
Corividae	+	+	+	+	+	+
Nena cinerea I	+	+	+	+		+
Panatra linearis I	+			+	+	
Notonecta sp	+		+	+	+	
Ilvocoris cimicoides (L.)	+	+	+	+	+	+
Bivalvia		1		'		
Pisidium en		+				
Sphaarium rivicola (Lamarck)	+	+	+			+
Draissana polymorpha (Pall)	+	+				
Anodonta anatina (L.)	+	+	+	+	+	
Anodonia analina (L.)		+	+		+	
Unio nictorum (L.)	+	+	+	+	+	
Unio tumidus Philipsson	+	+	+	+		
Unio crassus Philipsson	+					
Gastropoda						
Lymnaga stagnalis (L.)	+	+	+	+	+	+
Lymnueu stugnutis (L.) Padix an	, -	- -				
Raurs sp. Planorbarius cornaus (L.)	+	+	+ +	+ +	+ +	+ +
Anisus vortar (I)	+	+	+ +	Ŧ	+ +	+ +
Anisus VOILEX (L.) Dithomia tontaculata (L.)	Ŧ	-T -L	- -	-	-	-7 -
Theodorus fluviatilis (L.)	+	Ŧ	- -	- -	<u>ـــ</u>	Ŧ
Viningmus viningmus (L.)	+	1	- -	Ŧ	- -	+
Viviparus Viviparus (L.)	+	- -	- -		Ŧ	- -
viviparus contectus (Millet)	+	+	+	+		+

Table 2. Occurrence of benthic macrofauna in the ox-bow lakes in the years 2003–2004 Tabela 2. Występowanie makrofauny dennej w latach 2003-2004 w starorzeczach

No. 1-6 - like in Tab. 1.

Frequently collected were Gammaridae, Culicidae, bivalves of the family Unionidae, and snails of the family Viviparidae. Most taxa (28-30) of benthic invertebrates were found in ox-bow lakes Szumin, Wywłoka and Bużysko. The first two are connected with the river, the latter – Bużysko - is the largest among the studied ox-bow lakes.

The least taxa (22) were found in Lake Białe, the smallest among the ox-bow lakes studied, situated the farthest from the river and long ago separated from it with flood embankments. Biomass of benthos was diverse in the studied ox-bow lakes. The highest biomasses were noted in ox-bow lake Wywłoka (above 6.6 kg m⁻²) and in Szumin (about 4.3 kg m⁻²), the lowest in Lake Białe (below 200 g m⁻²). In other lakes biomass varied from several to several hundred g m⁻², always below 500 g m⁻² (Tab. 3).

Table 3. Fresh biomass of benthic macrofauna in six ox-bow lakes in the years 2003-2004 Tabela 3. Biomasa świeża makrofauny dennej sześciu starorzeczy Bugu w latach 2003-2004

No. – Nr	Ox-bow lake - Starorzecze	Biomass – Biomasa (g m ⁻²)
1	Szumin	3102-4310
2	Wywłoka	1789-6676
3	Bużysko	209-442
4	Wszebory	63-450
5	Przewóz Nurski	39-304
6	Białe Lake	10-197

Molluscs contributed most to the biomass of benthos (91-99%). Molluscs from the family Unionidae, *Dreissena polymorpha*, and snails of the family Viviparidae were extremely abundant in ox-bow lakes connected with the river (Szumin and Wywłoka). Their densities reached several hundred individuals per m² and maximum biomass – 6.5 kg m⁻².

DISCUSSION

All of the studied ox-bow lakes are astatic water bodies with substantial and irregular variability. They are situated in mostly agricultural catchment. Water and bottom sediments are also affected by hydrological regime. Szumin and Wywłoka are connected with the river and during spring floods are filled with river waters. Later on lake water with suspended matter flows back to the river channel. Other ox-bow lakes are isolated from the river and form a trap for substances of terrestrial origin. In spite of similar origin, size, small depth and initially similar water quality, the ox-bow lakes, after many years of existence, represent much advanced limnological specificity. Being relatively small and shallow, ox-bow lakes are functionally similar to lake littoral zone. The latter is the most diversified lake zone and mosaic character is its important feature [e.g. Pieczyńska 1976]. Therefore, great diversity of ox-bow lakes is not surprising.

The studied ox-bow lakes of the Bug differ in hydrology, chemical composition of water and bottom sediments and, most of all, in the composition and biomass of organisms. Particularly great differences were revealed when comparing permanently isolated lakes with those open to river waters. In lakes connected with the river more taxa, higher densities and greater biomass of benthic invertebrates were observed. Only there *Dreissena polymorpha* could be found. Noteworthy, the protected species *Unio crassus* from the "Polish Red Book of Endangered and Extinct species" and the only Polish representative of Bivalvia listed in the EU Habitat Directive [Głowaciński and Nowacki 2004] was present in Szumin. It is a typically riverine species which, however, can penetrate ox-bow lakes [Piechocki and Dyduch-Falniowska 1993, Piechocki 2002].

Ox-bow lakes can thus be naturally valuable water bodies deserving protection. Such a protection is provided by the Bug River Valley Landscape Park.

CONCLUSIONS

1. Ox-bow lakes of the Bug are much differentiated. They differ in hydrological regime, chemical composition of waters and bottom sediments, taxonomic composition and density of benthos.

2. Molluscs, mostly bivalves, dominated in the benthic biomass of the studied ox-bow lakes.

3. Ox-bow lakes connected with the Bug showed greater species diversity and biomass of the benthos than those permanently and long ago isolated from the river.

4. Ox-bow lakes deserve protection; rare species and species endangered by extinction can be found there.

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ZRÓŻNICOWANIE MAKROBENTOSU W STARORZECZU BUGU W NADBUŻAŃSKIM PARKU KRAJOBRAZOWYM

Streszczenie. Badaniami makrobentosu objęto sześć starorzeczy w różnym stopniu powiązanych z Bugiem – od silnie przepływowych do całkowicie odciętych. W starorzeczach tych notowano od 22 do 30 taksonów bezkręgowców, należących do pięciu gromad: Hirudinea, Malacostraca, Insecta, Gastropoda i Bivalvia. Bardzo duży udział, zwłaszcza w biomasie makrobentosu, stanowiły mięczaki (91-99%). Szczególnie bogate w małże z rodziny Unionidae, *Dreissena połymorpha* oraz w ślimaki z rodziny Viviparidae były starorzecza mające bezpośrednie połączenie z rzeką. Zagęszczenia tych grup mięczaków dochodziły miejscami do kilkuset osobników na 1 m² dna, a biomasy świeże z muszlami – do 6,5 kg na 1 m². Starorzecza połączone z Bugiem charakteryzowały się większą różnorodnością gatunkową makrobentosu niż starorzecza dawno i trwale odcięte od rzeki.

Slowa kluczowe: Nadbużański Park Krajobrazowy, starorzecza, bentos, mięczaki