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Molluscs (*Mollusca*) of the River Muchawka (South Podlasie Lowland, Siedlce Plateau, Poland)

Abstract: The study of molluscs of the River Muchawka in 1999 and 2000 revealed the presence of 12 species of molluscs, including 5 species of bivalves and 7 species of snails. Dominant species included *Pisidium amnicum* (L.) and *Sphaerium rivicola* (L.) among bivalves, and *Bithynia tentaculata* (L.) and *Lymnaea stagnalis* (L.) among snails. *Unio pictorum* (L.), a protected species, was recorded in the upper course and at the river mouth. The highest number of species were found in the upper watercourse and the lowest at sites near the river mouth.

Key words: molluscs, Muchawka River, fauna Poland

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INTRODUCTION

While studies of fresh water molluscs have had a long tradition in Poland, there is a dearth of research on the occurrence of molluscs in small rivers in lowland areas of our climatic zone (*e. g.* PIECHOCKI 1969, 1972, 1987a, KASPRZAK 1975, KOŁODZIEJCZYK 1994). There are areas in our country where molluscs have hardly been studied and these include the Podlasie region (PIECHOCKI & DYDUCH-FALNIOWSKA 1993).

The malacofauna of minor watercourses of the Siedlce Plateau [Wysoczyzna Siedlecka] (part of the South Podlasie Lowland [Nizina Południowopodlaska]) is not well known. Apart from papers by JAKUBIK *et al.* (2000), KRÓLAK & KORYCIŃSKA (2001) and KORYCIŃSKA (2002), no other data on the molluscs of these areas are available. Some mentions of species found in this region were made in KRÓLAK (1998), where the author presented the results of her studies of heavy metal content in the molluscs of the Siedlce Plateau.

The River Muchawka is the largest tributary of the Liwiec, the main river of the Siedlce Plateau. Flowing through agricultural areas, it is not too heavily polluted by municipal sewage and industrial waste, which makes the Muchawka an interesting object of study. What is known about the Muchawka amounts to a naturalist inventory by BAKIERA *et al.* (1993) and annual water quality reports by the Regional Environmental Protection Inspectorate based on physicochemical and biological characteristics. This paucity of information prompted me to carry out detailed faunistical studies on the river's malacofauna.

AREA AND METHODS OF STUDY

The River Muchawka is a left tributary of the Liwiec, originating about 2 km south of the village of Daćbogi and flowing across the Siedlce Plateau. The river is 29.7 km long and has a 292 sq. km catchment basin. The main tributaries of the Muchawka include the Zbuczynka, Myrcha and Mucha.

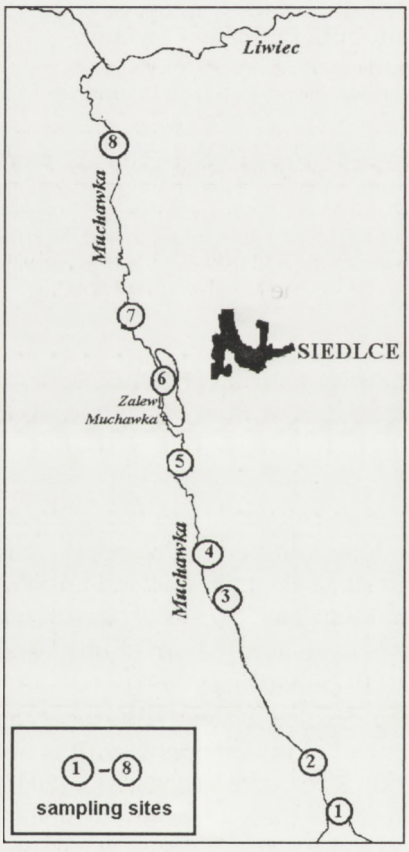

Figure. A map of the study area with study sites marked.

The river course forms a valley with meadows that are periodically waterlogged. The Muchawka valley is rich in flora, especially in vascular plants, with 399 species of these recorded (KOT & DOMBROWSKI 2001). The valley is a refuge to rare bird species during their migrations. There is a reservoir on the Muchawka which is recreationally important for the town of Siedlce (Raport 1997).

Eight study sites were selected along the Muchawka river course (Figure). Their characteristics are presented in Table I.

Samples for the determination of physical and chemical properties of the water and for the faunistic studies were obtained at 8 sites along the Muchawka river in 1999 and 2000 in spring, summer and autumn.

Water samples for chemical analyses were collected into polyethylene containers and fixed with 2–3 cm^3 of chloroform per 1 dm^3 of water (HERMANOWICZ *et al.* 1976). Measurements of oxygen dissolved in the water (using an EOT 196 oxygen probe), temperature, electrolytic conductivity of water (using a CC-317 conductivity meter) were performed at each site. Laboratory measurements included pH (by a CP-215 digital pH-meter), concentration of nitrates, phosphates and water hardness (using an LF-205 field photometer) and chlorides (by argentometry) (HERMANOWICZ *et al.* 1976).

Table I. Characteristics of study sites.

Site	Site characteristics			
	Type of bottom	Type of river bank	Sampling depth (cm)	Vegetation
1	sandy-loamy	high, strengthened with wood	50	*Elodea canadensis* MICHX, *Sagittaria sagittifolia* L., *Batrachium fluitans* LAM.WIMM.
2	sandy-stony	natural	20	*Sagittaria sagittifolia* L., *Nuphar lutea* L.SIBTH&SM, *Elodea canadensis* MICHX
3	sandy-loamy	natural, mildly sloping	30	*Elodea canadensis* MICHX, *Sigittaria sagittifolia* L., *Batrachium fluitans*LAM.WIMM., *Nuphar lutea* L.SIBTH&SM, *Lemna minor* L., *Veronica beccabunga* L.
4	sandy-loamy with detritus	natural, mildly sloping	30	*Potamogeton lucens* L., *Sagittaria sagittifolia* L.,*Nuphar lutea* L. SIBTH&SM, , *Lemna minor* L., *Elodea canadensis* MICHX
5	sandy-loamy	natural, mildly sloping	80	*Sagittaria sagittifolia* L., *Elodea canadensis* MICHX, *Potamogeton crispus* L., *Nuphar lutea* L.SIBTH&SM, *Veronica beccabunga* L., *Sparganium* sp.
6	loamy	natural, mildly sloping	40–60	*Sagittaria sagittifolia* L., *Elodea canadensis* MICHX, *Batrachium fluitans* LAM.WIMM., *Potamogeton lucens* L., *Nuphar lutea* L.SIBITH&SM
7	sandy-loamy	natural, mildly sloping	40–70	*Sagittaria sagittifolia* L., *Batrachium fluitans* LAM. WIMM., *Elodea canadensis* MICHX, *Potamogeton crispus* L., *Lemna minor* L., *Sparganium* sp.
8	sandy	natural, mildly sloping, sometimes steep	30–70	*Potamogeton crispus* L., *Potamogeton pectinatus* L., *Sagittaria sagittifolia* L., *Nuphar lutea* L.SIBTH&SM

Mean values of the physical and chemical parameters were calculated for spring, summer and autumn samples to determine average water quality in the Muchawka (Table II).

Table II. Water quality in the Muchawka.

Indices	Sites								Mean	Final score
	1	2	3	4	5	6	7	8		
Temperature (°C)	15.73	19.70	16.73	20.33	21.00	20.10	14.20	18.10	18.23	I
Acidity/alkalinity (pH)	7.53	7.66	7.66	7.86	7.86	7.53	7.40	7.37	7.61	I
Conductivity (mS/cm)	0.51	0.61	0.67	0.66	0.64	0.64	0.69	0.70	0.64	I
O_2 (mg/dm^3)	8.63	7.40	7.76	7.90	6.43	5.86	6.16	7.03	7.15	I
N_{NO3^-} (mg/dm^3)	1.53	1.46	0.67	0.52	0.49	0.56	0.75	0.65	0.83	I
N_{NH4} (mg/dm^3)	0.62	0.28	0.34	0.20	0.25	0.19	0.20	0.12	0.28	I
PO_4^{3-} (mg/dm^3)	0.43	0.43	0.36	0.33	0.43	0.46	0.40	0.30	0.39	II
Cl^- (mg/dm^3)	4.99	5.94	5.77	5.77	5.66	5.66	6.27	6.22	5.78	I
Hardness (mg $CaCO_3$/dm^3)	255	331	364	362	341	347	370	373	344.87	I

The annual mean values of the following physical and chemical parameters of water: acidity/alkalinity, specific electrolytic conductivity , oxygen concentration, nitrate and chloride concentration were within the limits for water quality class I (Table II),

only phosphate concentrations fell within the II class of water quality. The presence of agricultural land along the river course suggests surface outflow from fields and meadows as the main source of phosphates.

Samples of the benthos were obtained using a 20 x 20 cm grab sampler mounted on a 4 meter pole which was dragged parallel to the river bank over approximately 1 metre. Each sampling consisted of three repetitions of the procedure.

The material was sifted several times through a 0.5 x 1 mm mesh sieve on the site. In the laboratory, the material was fixed in 70% alcohol. Dominance indices were calculated according to the formula $D= n_i /N$, where n is the number of individuals of a species and N is the number of individuals of all species recorded. An index of species similarity (*MS*) was also used (MARCZEWSKI & STEINHAUS 1959), the formula being $S= w/(a+b-w)$, where a is the number of species in assemblage A, b is the number of species in assemblage B and w is the number of species common to both assemblages.

RESULTS

The malacofauna was diversified both quantitatively and qualitatively (Table III).

In 1999, the samples yielded a total of 189 individuals of molluscs. Dominant species included the bivalves *P. amnicum* (75 individuals) and *S. rivicola* (45 individuals). *P. amnicum* were found at all sites, especially in the middle and lower Muchawka, with the exception of site 8. *S. rivicola* were found at six sites, excluding Sites 2 and 3.

Single individuals of *U. pictorum*, a legally protected species, were found at four sites. Two sites (1 and 3) yielded *A. anatina* and one individual of *A. cygnea* was found at Site 1.

Among snails, *B. tentaculata* was the dominant and was found at five sites (in upper and lower course), with *L. stagnalis* as another dominant. The other species of snails: *L. peregra, L. auriculata, P. fontinalis, V. contectus, P. planorbis* were not abundant (2 to 5 individuals) and occurred only at some of the sites.

In 2000, the malacofauna of the River Muchawka was more abundant than in 1999 with, 249 individuals recorded. There was again a marked dominance of *P. amnicum* and *S. rivicola* among bivalves, with both species occurring at nearly all of the study sites. As in 1999,

A. anatina was reported from Sites 1 and 3 (14 individuals) and two individuals of *A. cygnea* were recorded at Site 1. A total of 13 *U. pictorum* individuals were found at four sites, like in 1999.

The dominant species among snails were: *L. stagnalis,* found at nearly all study sites, and *B. tentaculata,* recorded at five study sites in the upper and lower river course that year. The abundance of other snail species varied from two *P. planorbis* individuals (Sites 1 and 2) to 16 individuals of *L. auricularia* (most sites excluding those in the middle river course).

Species similarity analyses showed the highest degree of similarity between Sites 1 and 3 (0.82) and the lowest degree of similarity between Sites 2 and 8 (0.20) (Table IV).

Table III. Species composition and the numbers of individuals per 1 m² at 8 study sites in the Muchawka in 1999 [A] and 2000 [B].

No.	Species	Sites																N		D[%]	
		1		2		3		4		5		6		7		8					
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1	*Unio pictorum* (LINNAEUS, 1758)	1	2			2	5							2	3	1	3	6	13	3,2	5,2
2	*Anodonta anatina* (LINNAEUS, 1758)	4	6			5	8											9	14	4,8	5,6
3	*Anodonta cygnea* (LINNAEUS, 1758)	1	2															1	2	0,5	0,8
4	*Sphaerium rivicola* (LAMARCK, 1818)	8	10					12	10	8	6	4	6	9	11	4	6	45	49	23,8	19,8
5	*Pisidium amnicum* (O. F. MÜLLER, 1774)	3	2	1	2	4	10	6	8	22	18	13	10	26	29			75	79	39,7	31,7
6	*Lymnaea stagnalis* (LINNAEUS, 1758)	3	5			4	6	1	3		2	1	3	2	5	3	2	14	26	7,4	10,4
7	*Lymnaea peregra* (O. F. MÜLLER, 1774)		3		5		2					1		2	3			3	13	1,6	5,2
8	*Lymnaea auricularia* (LINNAEUS, 1758)		2	1	3	2	5			2	4		1		1			5	16	2,6	6,4
9	*Bithynia tentaculata* (LINNAEUS, 1758)	9	10	6	4		3					1		5	3	1	2	22	22	11,6	8,8
10	*Physa fontinalis* (LINNAEUS, 1758)			2					2			1					1	3	3	1,6	1,2
11	*Viviparus contectus* (MILLET, 1813)		1		1	1	3	1		2	4		1					4	10	2,1	4,1
12	*Planorbis planorbis* (LINNAEUS, 1758)	1	1		1	1												2	2	1,1	0,8
	Total	30	44	10	16	19	42	20	23	24	34	21	21	46	55	9	14	189	249	100,0	100,0
	Number of species	8	11	4	6	7	8	4	4	4	5	6	5	6	7	4	5				

Table IV. Values of Marczewski-Steinhaus index of species similarity (*MS*) for mollusc communities of study sites.

	1	2	3	4	5	6	7	8
1	x							
2	0.50	x						
3	0.82	0.60	x					
4	0.33	0.33	0.27	x				
5	0.45	0.33	0.40	0.67	x			
6	0.58	0.67	0.54	0.62	0.62	x		
7	0.64	0.40	0.60	0.33	0.33	0.67	x	
8	0.33	0.20	0.27	0.43	0.25	0.44	0.50	x

$MS \leq 0.33$ $0.34 < MS \leq 0.65$ $MS \geq 066$

DISCUSSION

The number of molluscs species found in the River Muchawka (12) is the same as that recorded from the River Mławka, but much lower than the number of species in the River Skierniewka, where 21 species were recorded (JURKIEWICZ-KARNKOWSKA 1989). The number of molluscan species in the Muchawka was also much lower than that found in the rivers Grabia and Pasłęka (PIECHOCKI 1969, 1972), Krutynia and Raba (HILBERT 1913, BERGER 1960, 1962, LEWANDOWSKI 1996), Łubrzanka, Łośna, Biała Nida, Czarna Nida (PIECHOCKI 1981), Psara, Świślina, Opatówka, Koprzywianka (PIECHOCKI 1987b), Szeszupa (LEWANDOWSKI 1990), Wieprz (PIECHOCKI & ŁUCZAK 1989, PIECHOCKI 1992), with about 40 species recorded in each of these watercourses.

Of the 12 species of molluscs identified in the Muchawka, seven were snails. This number is much smaller than 11 species found in 1998 in the Liwiec River (KORYCIŃSKA 2000, 2002), of which the Muchawka is a tributary. However, the species composition of the Liwiec assemblage was similar to that identified in the Muchawka. GRUŻEWSKI (2000) found as many as 25 species of molluscs (15 species of snails and 10 species of bivalves) in the River Pęza, which is a right tributary of the middle Narew and a much smaller river than the Muchawka. The same author found 13 species of molluscs in the River Kamionka in the Wigry National Park in a 1996 study.

The molluscan community of the Muchawka is characterised by a clear-cut dominance of two bivalve species *P. amnicum*, *S. rivicola* and two species of snails: *L. stagnalis* and *B. tentaculata*. The dominance of bivalves was evident in both years, with the two species mentioned above accounting on average for more than 50% of the total abundance of molluscs. According to PIECHOCKI & DYDUCH-FALNIOWSKA (1993), *P. amnicum* and *S. rivicola* are mostly found in lowland rivers. These bivalves usually inhabit unpolluted or moderately polluted waters (STADNIČENKO 1984). *P. amnicum* is particularly sensitive to pollution from industrial wastes and municipal sewage and does not thrive in highly eutrophic habitats. Thus, the presence of bivalves of the family *Unionidae* in the waters of the Muchawka testifies to a good quality of the water, which was also confirmed by the physicochemical analyses. Of particular importance

is the finding of *U. pictorum*, a legally protected species (Rozporządzenie 1995), at four sites (1, 2, 7 and 8) in upper and lower river. As the abundance of *Unionidae* in Polish rivers and lakes has been decreasing drastically, it is noteworthy that the Liwiec supported in 1996 and 1997 four species of bivalves of the family *Unionidae*: *A. anatina*, *U. pictorium*, *U. tumidus*, *U. crassus* (KRÓLAK & KORYCIŃSKA 2001, KORYCIŃSKA 2002).

The river bottom was sandy and loamy all across the section studied, with occasional stones. This promotes the growth of certain species of snails. *L. stagnalis* and *B. tentaculata* were snails with a considerable share in the dominance structure of the Muchawka River molluscan community. Both species show a preference for the kind of bottom found in the Muchawka and are characteristic of lowland rivers (JACKIEWICZ 2000). The presence of Lymnaeidae in the river also demonstrates a good quality of its water (JACKIEWICZ 2000). Lymnaeidae are used as an indicator of water quality as they are found in waters with oxygen content in the range of 5.0–9.0 mg $0_2/dm^3$ in beta-meso-saprobic zones (MICHAŁKIEWICZ 1993).

The upper river course supported the highest diversity and numbers of species in both years of study, with Site 1 supporting 8 species in 1999 and 11 species in 2000 and Site 3 supporting 7 species in 1999 and 8 species in 2000. The observed diversity at these sites was due to the characteristics of the river bottom mentioned earlier and the development of vegetation. Bivalves found in these habitats, mainly *Unionidae*, *Pisidium sp.* as well as *Sphaerium sp.* prefer a sandy or sandy-loamy bottom with considerable vegetation cover (PIECHOCKI 1992). Conversely, *A. cygnea* and *A. anatina* are being found in rivers with a bottom of coarse gravel or covered with stones, as at the sites where these species were recorded. A sandy or sandy-loamy bottom chiefly supports representatives of *Lymnaeidae*, *Bithyniidae*, *Viviparidae* (PIECHOCKI 1979). Overgrown source streams in the upper courses of lowland rivers offer much better habitat conditions compared to middle or lower courses. This has been confirmed by the differences found in the number of snail species recorded in sites near the springs and in the middle and lower course of the Muchawka. Similar findings have been reported by KORYCIŃSKA (2000) for snails of the Liwiec and by LEWIN (2001) for snails in reservoirs and rivers of the Ciechanów Plateau [Wysoczyzna Ciechanowska].

This diversification of species composition in each of the designated parts of the river was further confirmed by species similarity indices, which were lowest for sites in the upper and lower river course (0.20) and highest for sites in the upper and middle course (0.82). The observed differences in species similarity are related to the differences in habitat conditions and the physical and chemical properties of water in the study habitats.

The mollusc fauna of the River Muchawka reflects the undisturbed character of this small lowland river (WIŚNIEWSKI *et al.* 1985, JURKIEWICZ-KARNKOWSKA 1989, RACZYŃSKA 1999, GRUŻEWSKI 2000).

This preliminary analysis of the mollusc fauna of the Muchawka should be extended to include data from more detailed comprehensive studies carried out over a number of years and also in the tributaries of the Muchawka.

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STRESZCZENIE

[Tytuł: Mięczaki (*Mollusca*) rzeki Muchawka (Nizina Południowopodlaska, Wysoczyzna Siedlecka, Polska)]

W latach 1999–2000 dokonano oceny składu gatunkowego oraz struktury dominacji mięczaków rzeki Muchawka (lewobrzeżny dopływ Liwca). Odnotowano występowanie 12 gatunków mięczaków a w tym 7 gatunków ślimaków i 5 gatunków małży. Dominantem w obydwu latach badań było *Pisidium amnicum* (MÜLL.). Do gatunków współdominujących zaliczono *Sphaerium rivicola* (L.), *Lymnaea stagnalis* (L.), *Bithynia tentaculata* (L.). Gatunkami rzadkimi, reprezentowanymi przez 1 – 2 osobniki były: *Anodonta cygnea* (L.), *Planorbis planorbis* (L.), *Physa fontinalis* (L.). Na czterech stanowiskach (1, 2, 7 i 8) w górnym i ujściowym odcinku rzeki stwierdzono obecność *Unio pictorum* (L.) – gatunku objętego ochroną gatunkową. Malakofauna rzeki Muchawka jest charakterystyczna dla małej rzeki nizinnej.