

The structure of macrozoobenthic communities in the Tywa River, a right-bank tributary of the Oder River (northwest Poland)

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Abstract

Research relating to the subject of this paper was conducted on the Tywa River between September 1996 and July 1998. In the samples, invertebrates were found belonging to 46 species, 26 genera, and two subfamilies. In the 1996 season, the highest abundance was observed among Tanypodinae (larvae) at 10,878 ind. m⁻²; among Chironominae (larvae) it was 9,965 ind. m⁻²; and among *Tubifex tubifex* it was 2,605 ind. m⁻². The maximum total density of macrozoobenthic forms in the Tywa River was at station no. 1, where it amounted to 23,953 ind. m⁻². The quantitative structure in the 1997 season was lower than in the 1996 season, and the highest abundance was for *Simulium* sp. (larvae) at 5,196 ind. m⁻²; for Tanypodinae it was 3,360 ind. m⁻²; and for *Dreissena polymorpha* it was 4,721 ind. m⁻²; and for *Theodoxus fluviatilis* – it was 4,114 ind. m⁻². In this season, the biodiversity of the macrozoobenthic community was the highest of all

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seasons. In 1998, the qualitative structure of the macrozoobenthic community was low: Hirudinea disappeared, and the quality of the community was almost four times lower than in 1996. The river's fast current, its diverse substratum, its very good oxygenation, and moderate concentrations of organic matter created conditions appropriate for species that differ in their requirements.

INTRODUCTION

The distinguishing characteristic of watercourses as biocenoses is their considerable flexibility. Organisms living there are adapted to sharp fluctuations in environmental conditions. Flexibility and fluctuations in the habitat provide and maintain a diversity of living organisms, as well as their biocenoses (Hillbricht-Ilkowska 1998). Research conducted into zoocenosis, and into interactions between the biotic and abiotic environment of the Tywa River, made it possible to determine biodiversity at the level of the ecosystem and biotope. Situated in the southern part of Szczecin Province, the Tywa River is a right-bank tributary of the lower Oder River. Its headwaters are located in the region of the town of Trzcińsko Zdrój. The Tywa River mouth to the Oder is near the town of Gryfino. The total course of the Tywa River is 48.0 km and its lower course (about 5 km) lies in the protection zone of The Lower Oder Valley International Landscape Park. Thus, this part of the river and its catchment area are under legal protection.

MATERIALS AND METHODS

Biocenotic research on the Tywa River began in September 1996 and was conducted for the following two years. The study focused on macrobenthos, water chemistry, and hydrological parameters. The material for the research was collected in each limnological season on the following dates: 10.09.1996, 09.12.1996, 10.07.1997, 26.07.1997, 17.09.1997, 9.12.1997, 27.04.1998, and 21.07.1998. The material was collected from eight sampling sites located near 6.0 km, so that unique conditions of the river ecosystem and pollution discharged to the Tywa River could be taken into account (Fig. 1): station 1 – Góralice (48.0 km), station 2 – Trzcińsko Zdrój (45.4 km), station 3 – Swobnica (36.0 km), station 4 – Banie (28.1 km) (located 500 m from Lake Dłużec), station 5 – Trzaski (22.1 km), station 6 – Borzym (14.7 km), station 7 – Wirówek (8.0 km), and station 8 – Gryfino (3.0 km) (Fig. 1).

Macrozoobenthos samples were collected with a Surber sampler (mesh size 0.5 mm) from a bottom surface area of 20 × 20 cm. The material obtained was preserved with 4% buffered formalin. In the laboratory, all invertebrates were examined under magnification of ×10, and as far as possible identified to the

species level. The numbers of individuals of each taxon were counted and expressed per 1 m² (Table 1 – 3).

Water samples were taken in plastic containers. In the laboratory, chemical analyses were performed with standard methods (Hermanowicz et al. 1999, Standard methods 1995).

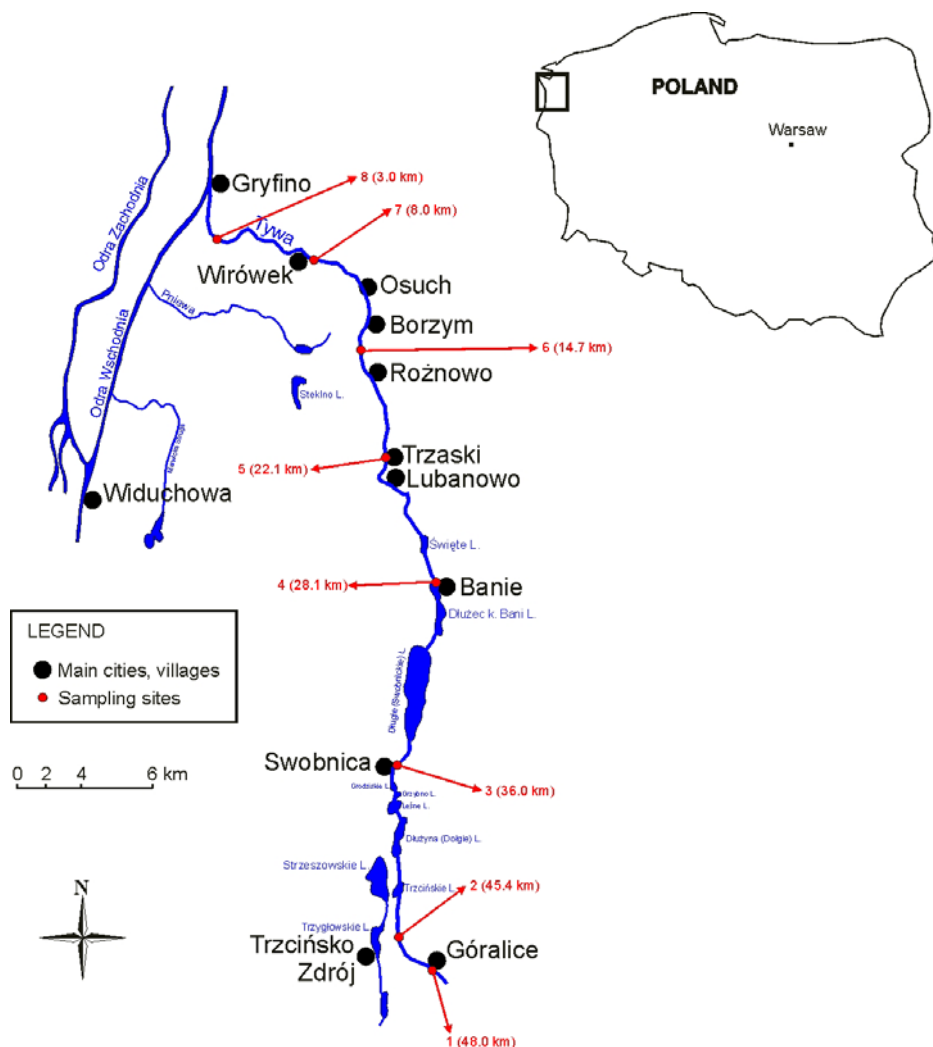


Fig. 1. Location of the Tywa River drainage area and location of sampling sites.

RESULTS AND DISCUSSION

The density of some species and the structure of species dominance continuously changed along the entire river. Because of the spatial variability of its flow, the Tywa River is classified as both a lowland and a mountain river. It is a typical lowland river in its upper course, with a muddy and sandy substratum on its bottom: this is the case at station 1 - Góralice, station 3 - Swobnica, station 4 - Banie, and station 7 - Wirówek. The dominant species of bottom fauna in this course of the river are the larvae of flies (subfamilies Tanyptodinae, Chironominae, and *Simulium* sp.) and the oligochaetes *Tubifex tubifex* (Table 1 - 3). At sampling site 1, where the bottom is soft and muddy, water flow is quite high (Table 1, 2). An interesting phenomenon was observed in 1996 and 1997 when *T. tubifex* was found there. It is difficult to give convincing reasons for this result. No drastic changes in physicochemical and hydrological parameters were observed at that time (Table 4). It is also worth paying attention to a result from sampling site 3 in 1996 and 1997, where leeches *Erpobdella monostrata* (Tables 1, 2) were found, although they prefer a rocky bottom and fast-flowing current. They were often accompanied by rheophilous fauna (Agapow 1982). The natural habitat for such leeches in the Tywa River would be rather that of sampling site 2 in the upper reach of the river. Because only 15 ind. m⁻² of the species were found at sampling site 3 in 1996, it can be assumed that the species was brought by the water current from the upper reach of the river (Table 1).

In the middle reach of the river increased diversity was observed of species that belong to macrozoobenthos. At sampling site 4, because of the character of its bottom (hard, with gravel, and sandy) (Table 4), and because limnetic water influenced this site, the number of organisms and their density increased. During the research Oligochaeta and Bivalvia dominated interchangeably. Among them, one species, *Dreissena polymorpha*, was present at the highest density (in 1997, site 4 – 4,721 ind. m⁻²). As it prefers a hard bottom and a slow-flowing current, it also plays a significant role as a bioeston filter-feeder (Kajak 1975; Stańczykowska 1975, 1977; Lewandowski 1982; Piesik 1983; Włosik-Bieńczyk 1997). Presumably because of such a high density of *D. polymorpha* at this sampling site, the level of nutrients was significantly lower in comparison with other sampling sites (Table 5). Despite its sedentary life, significant changes in the density of this bivalve in the examined watercourse were observed (Tables 1-3). However, the reason for this situation is still unclear. Stańczykowska (1977) and Lewandowski (1982) argue that the amount of suspended matter in water and the mortality of plankton larvae are the reasons for changes in the population density of bivalves. However, further

research is required to find reasons for quantitative changes in the population of *D. polymorpha* at sampling site 4 in the Tywa River.

Table 1

Density (ind. m⁻²) of the macrozoobenthos community at the sampling sites in the River Tywa in 1996 (l.) – larvae, (p.) – pupa.

No.	Taxon	Station	1	2	3	4	5	6	7	8
1	Gastropoda									
1.1	<i>Theodoxus fluviatilis</i> (L.)							148	30	
1.2	<i>Viviparus viviparus</i> (L.)				15	311				
1.3	<i>Bithynia leachi</i> (Sheppard, 1823)						44			
1.4	<i>Bithynia tentaculata</i> (L.)				15	222			89	
1.5	<i>Ancylus fluviatilis</i> O.F.Müller, 1774								15	
2	Bivalvia									
2.1	<i>Sphaerium</i> sp.					119	340	30	30	30
2.2	<i>Pisidium</i> sp.					163		341	15	15
2.3	<i>Dreissena polymorpha</i> (Pallas, 1771)					133				
3	Oligochaeta									
3.1	<i>Tubifex tubifex</i> (O.F.Müller, 1774)		2.605		45	1.287	207	59	104	1.450
4	Hirudinea									
4.1	<i>Glossiphonia complanata</i> (L.)				15	15		15		
4.2	<i>Helobdella stagnalis</i> (L.)					15				
4.3	<i>Haemopis sanguisuga</i> (L.)					15				
4.4	<i>Erpobdella monostrata</i> (Lindfeld et Pietruszyński)			15	15					
5	Amphipoda									
5.1	<i>Gammarus fossarum</i> Koch, 1836		15					44	30	
5.2	<i>Gammarus roeselii</i> Gervais, 1835		15	15			59		148	
6	Isopoda									
6.1	<i>Asellus aquaticus</i> (L.)		89	15					30	
7	Ephemeroptera							30		
8	Odonata		30							
9	Heteroptera								15	
10	Megaloptera						15		15	
11	Coleoptera			15				30		
12	Trichoptera									
12.1	<i>Hydropsyche angustipennis</i> (L.) (Curtis, 1834)			193	15	30	88			
12.2	<i>Hydropsyche pellucidula</i> (L.) (Curtis, 1834)							59	15	
12.3	<i>Potamophylax rotundipennis</i> (L.) (Brauer, 1857)								44	
12.4	<i>Athrisodes bilineatus</i> (L.) (L.)					59				
13	Diptera									
13.1	<i>Dicranota bimaculata</i> (L.) (Schummel, 1829)								15	
13.2	<i>Tipula</i> sp. (L.)				59			45	44	
13.3	<i>Chironomidae</i> (p.)		326							15
13.4	<i>Chironominae</i> (l.)		9.965		30					
13.5	<i>Tanypodinae</i> (l.)		10.878	30	2.338	148	45	15	222	740
13.6	<i>Atrichopogon fuscus</i> (L.) (Meigen, 1804)				15					
13.7	<i>Simulium</i> sp. (L.)		30	6.823	15					
13.8	<i>Tabanus</i> sp. (L.)								118	
TOTAL			23.953	7.106	2.577	2.517	798	816	979	2.250

Table 2

Density (ind. m⁻²) of macrozoobenthos at the individual sampling sites in the River Tywa in 1997 (l.) – larvae, (p.) – pupa.

No.	Taxon	Station	1	2	3	4	5	6	7	8
1	Turbellaria									
1.1	<i>Dendrocoelum lacteum</i>						15			30
1.2	<i>Dugesia lugubris</i>					296				
2	Gastropoda									
2.1	<i>Theodoxus fluviatilis</i> (L.)					148		888	30	
2.2	<i>Viviparus viviparus</i> (L.)								45	
2.3	<i>Bithynia tentaculata</i> (L.)					400	30		15	
2.4	<i>Ancylus fluviatilis</i> O.F.Müller, 1774								104	
3	Bivalvia									
3.1	<i>Sphaerium</i> sp.	1.806	45		163	148	902	30	44	
3.2	<i>Pisidium</i> sp.	178			74		725	163	30	
3.3	<i>Dreissena polymorpha</i> (Pallas, 1771)				4721					
3.4	<i>Anodonta anatina</i> (L.)				44					
4	Oligochaeta									
4.1	<i>Tubifex tubifex</i> (O.F.Müller, 1774)	1.569	134	310	4.026	548	473	251	592	
5	Hirudinea									
5.1	<i>Glossiphonia complanata</i> (L.)		15		30	15				
5.2	<i>Helobdella stagnalis</i> (L.)		15	30	30	15				15
5.3	<i>Piscicola geometra</i> (L.)					15				
5.4	<i>Erpobdella monostrata</i> (Lindfeld et Pietruszyński)				15					
5.5	<i>Erpobdella nigricollis</i> (Brandes, 1900)				44	15				
5.6	<i>Erpobdella octoculata</i> (L.)				148	59				
6	Amphipoda									
6.1	<i>Gammarus fossarum</i> Koch, 1836	148	30				1.169	162	192	
6.2	<i>Gammarus roeselii</i> Gervais, 1835	902	192			1525	415	814		
7	Isopoda									
7.1	<i>Asellus aquaticus</i> (L.)	770	30			267				
8	Decapoda									
8.1	<i>Orconectes limosus</i> (Raffinesque, 1817)			44						
9	Ephemeroptera		44	15	30	134	30	30	15	
10	Odonata			15	118					
11	Heteroptera		15							74
12	Megaloptera	15							15	
13	Coleoptera		133	15			401			207
14	Trichoptera									
14.1	<i>Neuroclipsis bimaculata</i> (L.) (L., 1761)				15					
14.2	<i>Rhyacophila nubila</i> (L.) (Zetterstedt, 1840)									15
14.3	<i>Psychomyia pusilla</i> (L.) (Fabricius, 1781)									1.465
14.4	<i>Hydropsyche</i> sp. juv. (L.) Pictet, 1834				15					30
14.5	<i>Hydropsyche angustipennis</i> (L.) (Curtis, 1834)		149		15	2.768	15			
14.6	<i>Hydropsyche pellucidula</i> (L.) (Curtis, 1834)						89	15		296
14.7	<i>Hydropsyche siltalai</i> (L.) Doepler, 1963						74			104
14.8	<i>Isonychia dubia</i> (L.) (Stephens, 1837)		15							
14.9	<i>Limnephilus lunatus</i> (L.) Curtis, 1834		15							
14.10	<i>Potamophylax latipennis</i> (L.) (Curtis, 1834)					15				30
14.11	<i>Potamophylax rotundipennis</i> (L.) (Brauer, 1857)						15	44		
14.12	<i>Halesus</i> sp. (p.) Stephens, 1837		30							
14.13	<i>Halesus digitatus</i> (L.) (Schränk, 1781)							30		
14.14	<i>Halesus tessellatus</i> (L.) (Rambur, 1842)						30	15	15	

No.	Taxon	Station	1	2	3	4	5	6	7	8
14.15	<i>Athrisodes bilineatus</i> (L.) (L.)					178				
14.16	<i>Athrisodes cinereus</i> (L.) (Curtis, 1834)					15				
15	Diptera									
15.1	<i>Dicranota bimaculata</i> (L.) (Schummel, 1829)							163	15	163
15.2	<i>Tipula</i> sp. (L.)			89				74	45	15
15.3	<i>Dixa</i> sp. (L.)	15		44						15
15.4	<i>Chaoborus</i> sp. (L.)	163		15			74			
15.5	<i>Culex</i> sp. (p.)								30	15
15.6	<i>Chironomidae</i> (p.)	340	15	30		59				15
15.7	<i>Chironominae</i> (L.)	503			15	89				
15.8	<i>Tanyptodinae</i> (L.)	3.360	148	2.678	961	2.501	386	1.421	1.317	
15.9	<i>Culicoides</i> sp. (L.)			15					15	
15.10	<i>Bezzia</i> sp. (L.)						15			
15.11	<i>Atrichopogon</i> sp. (L.)						15			
15.12	<i>Simulium</i> sp. (L.)	89	5.196						74	
15.13	<i>Simulium</i> sp. (p.)		1.531			15				
15.14	<i>Atherix ibis</i> (L.) (Fabricius, 1798)				15					
15.15	<i>Tabanus</i> sp. (L.)		15						30	
15.16	<i>Clinocera</i> sp. (L.) Meigen, 1804									15
TOTAL			9.962	7.856	3.211	11.516	8.307	5.879	3.393	4.709

In the same reach, leech species were found that are typical for lotic water. These were: *E. octoculata*, *E. nigricollis*, *Helobdella stagnalis*, and *Glossiphonia complanata* (Agapow 1975). However, because of flow velocity, the number of leeches decreased at sampling site 4, as well as over the entire Tywa River. This is in agreement with the research conducted by Agapow (1982) on leeches in the Myśliborskie Lake District. In its middle course, 5 km from the river source, and in its lower course, the Tywa River takes on the character of a mountain river. Its flow is as high as 0.36 m s^{-1} , and the structure of its bottom changes to a stony, sandy one: station 2 - Trzcińsko Zdrój, station 5 - Trzaski, station 6 - Borzym, station 8 - Gryfino (Table 4). At these sampling stations in seasons 1996 – 1998, bottom fauna were represented by the larvae of Diptera, the larvae of caddis flies, Bivalvia, Oligochaetes, and Gammaridae. At sampling site 2 the genus *Simulium* was dominant (Table 1-2). Its density in 1996 and 1997 exceeded $6,823 \text{ ind. m}^{-2}$ (Table 1), which was mainly due to the river's fast-flowing current (Table 4) and the type of its river-bed (hard with big stones). The next year, density was $5,196 \text{ ind. m}^{-2}$, and in 1998 the genus was absent (Table 2 and 3). Presumably the widening of the river-bed (from 1.20 to 1.50 m) (Table 4), and maintenance work that had to be done there had an indirect impact on the decrease in density of *Simulium* spp. As a result of these changes, its natural habitat was destroyed, the character of the bottom was changed, and flow velocity decreased twofold (Table 4). The temperature in spring and summer, in seasons 1997 and 1998, was higher as well, compared with that of the previous year (Table 4). This could have speeded up the life

Table 3

Density (ind. m⁻²) of macrozoobenthos at the individual sampling sites in the River Tywa in 1998 (l.) – larvae, (p.) – pupa.

No.	Taxon	Station	1	2	3	4	5	6	7	8
1	Turbellaria									
1.1	<i>Dendrocoelum lacteum</i>								104	
2	Gastropoda									
2.1	<i>Theodoxus fluviatilis</i> (L.)				89		3.922	178	45	
2.2	<i>Viviparus viviparus</i> (L.)							89		
2.3	<i>Bithynia tentaculata</i> (L.)			15	30		15	44		
2.4	<i>Planorbis comeus</i> (L.)					44				
2.5	<i>Ancylus fluviatilis</i> O.F.Müller, 1774							30		
3	Bivalvia									
3.1	<i>Sphaerium</i> sp.	326			44	163	267		15	
3.2	<i>Pisidium</i> sp.	503	340	15	1.850	15				
3.3	<i>Dreissena polymorpha</i> (Pallas, 1771)					15				
3.4	<i>Anodonta anatina</i> (L.)				30					
4	Oligochaeta									
4.1	<i>Tubifex tubifex</i> (O.F.Müller, 1774)	15	162	177	1.051	444	133	148	207	
5	Amphipoda									
5.1	<i>Gammarus fossarum</i> Koch, 1836	74	45			89	415	89	89	
5.2	<i>Gammarus roeselii</i> Gervais, 1835	444	44			696		444		
6	Isopoda									
6.1	<i>Asellus aquaticus</i> (L.)		15		59			44		
7	Decapoda									
7.1	<i>Orconectes limosus</i> (Raffinesque, 1817)							30		
8	Ephemeroptera		59	15			592	15		
9	Odonata									
10	Megaloptera	15						45	297	
11	Coleoptera						59			
12	Trichoptera									
12.1	<i>Psychomyia pusilla</i> (L.) (Fabricius, 1781)								74	
12.2	<i>Hydropsyche angustipennis</i> (L.) (Curtis, 1834)					326				
12.3	<i>Hydropsyche pellucidula</i> (L.) (Curtis, 1834)						266		296	
12.4	<i>Limnephilus lunatus</i> (L.) Curtis, 1834	30								
12.5	<i>Potamophylax latipennis</i> (L.) (Curtis, 1834)							30	30	
12.6	<i>Potamophylax rotundipennis</i> (L.) (Brauer, 1857)						710	192		
12.7	<i>Halesus digitatus</i> (L.) (Schränk, 1781)							15		
12.8	<i>Halesus tessellatus</i> (L.) (Rambur, 1842)						459			
13	Diptera									
13.1	<i>Dicranota bimaculata</i> (L.) (Schummel, 1829)		15						15	
13.2	<i>Limonia</i> sp. (L.)							15		
13.3	<i>Tipula</i> sp. (L.)		44							
13.4	<i>Dixa</i> sp. (L.)			15		30			44	
13.5	<i>Chironomidae</i> (p.)	59						30		
13.6	<i>Chironominae</i> (L.)					15				
13.7	<i>Tanypodinae</i> (L.)	976	74	1.214	237	2.116	133	429	3.463	
13.8	<i>Tabanus</i> sp. (L.)						15			
TOTAL			2.442	798	1.451	3.390	3.953	6.986	1.986	4.575

Table 4

Average and extreme values of hydrological factors on the River Tywa from 1996 to 1998 at the sampling sites.

Values	1996/97			1997/98		
	min	max	mean	min	max	mean
Station 1 – Góralice (48.0 km)						
Width [m]	1.00	1.00	1.00	1.00	1.00	1.00
Mean depth [m]	0.08	0.40	0.23	0.12	0.64	0.39
Mean flow velocity [m s ⁻¹]	0.02	0.22	0.11	0.01	0.29	0.11
Bottom substrate	mud					
Station 2 – Trzcińsko Zdrój (45.4 km)						
Width [m]	1.20	1.20	1.20	1.20	1.50	1.22
Mean depth [m]	0.12	0.21	0.18	0.12	0.38	0.19
Mean flow velocity [m s ⁻¹]	0.36	1.00	0.61	0.24	1.00	0.69
Bottom substrate	stones					
Station 3 – Swobnica (36.0 km)						
Width [m]	2.00	2.00	2.00	2.00	2.00	2.00
Mean depth [m]	0.23	0.41	0.33	0.20	0.48	0.37
Mean flow velocity [m s ⁻¹]	0.11	0.66	0.28	0.11	0.48	0.29
Bottom substrate	sand, stones					
Station 4 – Banie (28.1 km)						
Width [m]	4.20	4.20	4.20	4.20	4.20	4.20
Mean depth [m]	0.60	0.96	0.78	0.68	1.00	0.79
Mean flow velocity [m s ⁻¹]	0.02	0.16	0.09	0.04	0.19	0.11
Bottom substrate	stones, sand					
Station 5 – Trzaski (22.1 km)						
Width [m]	4.00	6.00	4.30	4.00	4.00	4.00
Mean depth [m]	0.20	0.56	0.39	0.21	0.60	0.40
Mean flow velocity [m s ⁻¹]	0.17	0.36	0.19	0.12	0.31	0.22
Bottom substrate	stones, sand					
Station 6 – Borzym (14.7 km)						
Width [m]	5.00	5.00	5.00	5.00	5.00	5.00
Mean depth [m]	0.18	0.52	0.28	0.21	0.78	0.40
Mean flow velocity [m s ⁻¹]	0.21	0.50	0.32	0.21	0.57	0.37
Bottom substrate	stones, sand					
Station 7 – Wirówek (7.0 km)						
Width [m]	3.20	3.20	3.20	3.20	3.20	3.20
Mean depth [m]	0.54	0.75	0.65	0.42	0.71	0.61
Mean flow velocity [m s ⁻¹]	0.12	0.44	0.29	0.03	0.50	0.26
Bottom substrate	mud, sand					
Station 8 – Gryfino (3.0 km)						
Width [m]	4.00	4.00	4.00	4.00	4.00	4.00
Mean depth [m]	0.31	1.20	0.53	0.28	0.55	0.43
Mean flow velocity [m s ⁻¹]	0.16	0.62	0.38	0.22	0.60	0.40
Bottom substrate	sand, stones					

cycle of Simuliidae larvae and pupae. Presumably, they had occurred there before the samples were collected.

However, the highest biodiversity was a distinguishing characteristic of the middle reach of the river. At sampling site 5 Diptera, Bivalvia and Oligochaeta, Trichoptera and Amphipoda were dominant interchangeably in individual

seasons (Table 1-3). Moreover, at this site representatives of Isopoda, Hirudinea, Ephemeroptera, Turbellaria were also found. However, at sampling site 6, molluscs were dominant, and, among caddis-flies, Trichoptera were dominant, as well as such species as *Hydropsyche angustipennis*, *H. pellucidula*, *H. siltalai*, *Potamophylax rotundipennis*, and *Halesus tessellatus* (Table 1-3), i.e. species that most frequently inhabit small rivers (Czachorowski 1988, 1989, 1990).

Sampling sites 7 and 8 at the lower reach of the river were still distinguished by significant species diversity. However, the structure of domination changed. At sampling site 7, the bottom (sandy with a thick layer of silt) (Table 4) had a significant impact on the species structure of benthos,

Table 5

Average and extreme values of physico-chemical factors of water in the River Tywa from 1996 to 1998.

Parameters \ Values	min	max	mean	min	max	mean
	10.09.96			17.09.97		
Temperature [°C]	11.0	14.0	12.5	11.5	16.7	13.8
Dissolved oxygen [mgO ₂ dm ⁻³]	8.3	11.0	9.5	8.3	12.5	10.3
BOD ₅ [mgO ₂ dm ⁻³]	2.4	5.4	4.0	0.5	8.8	4.03
Total hardness [mgCaCO ₃ dm ⁻³]	5.9	9.5	7.5	4.8	8.6	6.39
Total suspended particulates [mg dm ⁻³]	2.0	14.0	8.0	37.0	84.0	51.5
	09.12.96			09.12.97		
Temperature [°C]	1.7	2.7	2.3	3.0	4.4	3.54
Dissolved oxygen [mgO ₂ dm ⁻³]	8.3	12.3	10.6	9.8	13.4	11.9
BOD ₅ [mgO ₂ dm ⁻³]	2.1	5.3	3.6	1.4	8.0	3.7
Total hardness [mgCaCO ₃ dm ⁻³]	5.7	9.9	7.4	5.0	12.4	7.1
Total suspended particulates [mg dm ⁻³]	5.0	58.0	21.1	11.0	67.0	37.6
	26.04.97			27.04.98		
Temperature [°C]	7.2	10.5	9.5	12.6	15.3	14.6
Dissolved oxygen [mgO ₂ dm ⁻³]	10.9	12.7	11.9	7.0	11.7	9.3
BOD ₅ [mgO ₂ dm ⁻³]	1.0	3.8	2.4	2.9	7.4	4.9
Total hardness [mgCaCO ₃ dm ⁻³]	5.7	9.9	7.0	6.1	10.8	7.7
Total suspended particulates [mg dm ⁻³]	1.0	89.0	19.3	3.0	49.0	29.6
	10.07.97			21.07.98		
Temperature [°C]	15.1	21.8	18.2	14.9	21.6	18.1
Dissolved oxygen [mgO ₂ dm ⁻³]	6.1	13.0	9.6	3.8	9.1	6.9
BOD ₅ [mgO ₂ dm ⁻³]	3.0	4.9	4.1	2.0	7.4	3.6
Total hardness [mgCaCO ₃ dm ⁻³]	5.7	10.5	7.1	5.1	10.3	6.9
Total suspended particulates [mg dm ⁻³]	1.0	49.0	12.0	55.0	159.0	98.8

because some species prefer this kind of bottom. These species belong to the following: Gammaridae, Oligochaeta, Tanypodinae larvae, and some caddis-flies (Table 1-3). At sampling site 8, the dominant species were those that prefer silt-covered bottoms (*T. tubifex* and Tanypodinae larvae), except for April and July 1997, when Trichoptera larvae occurred in a larger number. The mean density in 1997 (Table 2) of species of caddis-flies such as *H. pellucidula* and *Psychomyia pusilla* was 296 and 1,465 ind. m⁻², respectively. The species *P. pusilla* is characteristic for low water trophicity (Czachorowski 1998), and presumably migrated there in order to find food.

The hydrochemical conditions in the Tywa River influenced quantitative and qualitative structure to a lesser extent. Its water was generally well-oxygenated. This, in turn (min. – 3.8 mgO₂ dm⁻³, max. – 13.4 mgO₂ dm⁻³), was the result of a low content of organic matter (BOD₅ min. – 0.5 mg dm⁻³, max. – 8.8 mg dm⁻³) (Table 5). Also water hardness (min. – 4.8 mgCaCO₃ dm⁻³, max. – 12.4 mgCaCO₃ dm⁻³) did not restrict or reduce the size of populations of bivalves or molluscs, and their size remained at a level typical for hard water. Suspended matter (min – 1.0 mg dm⁻³, max – 159 mg dm⁻³) influenced changes in diversity and in species abundance most significantly. At sampling sites 1, 3, and 8, the level of suspended matter was high in some seasons and species diversity decreased and, generally, Diptera or Gammaridae, Isopoda, and some Trichoptera started to dominate.

CONCLUSIONS

The results of the above research showed that the hydrobiont structure depends on hydrological conditions (river flow, bottom substratum). All the factors determined by the research show a great deal of temporal and spatial changeability.

On account of the spatial variability of its flow, the Tywa River is classified both as a lowland and a mountain river. It is a typical lowland river in its upper course with a muddy, sandy bottom substratum. The dominant species of bottom fauna in this course of the river are the larvae of flies (subfamilies Tanypodinae and Chironominae) and the oligochaete *T. tubifex*. The total number of organisms was as high as 23,864 ind. m⁻² (station 1 – 1996). In the middle course, 5 km from the river source, the Tywa becomes a mountain river - its flow is as high as 0.91 m s⁻¹, and the structure of its bottom changes to a stony and sandy one. The dominant hydrobionts are the larvae of *Simulium* spp. at 6,823 ind. m⁻², and the larvae of caddis flies (mainly *H. angustipennis* – 193 ind. m⁻²).

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