ACTA HYDROBIOL.	18	1	75—87	KRAKÓW 1976

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Skąposzczety *(Oligochaeta)* rzeki Raby

Oligochaetes *(Oligochaeta)* of the Rievr Raba

Wpłynęło 23 stycznia 1975 r.

Abstract — *Oligochaeta* of the River Raba, a fairly small river in the West Carpathian Mts (185 to 1240 m above sea level), were elaborated within the framework of collective hydrobiological investigations carried out in the years 1969—1970. The material was collected at 11 stations. A list of species of *Oligochaeta* and their distribution along the course of the river are given. Dominance of particulra species or genera at successive stations was calculated separately for the lotic and lenitic habitats and upon the basis of the obtained results the problem of zonation of oligochaetes along the river was considered.

The present paper is part of a collective hydrobiological investigation of the River Raba carried out in the years 1967—1970 with the object of a thorough study of the flora and fauna inhabiting the river and also in order to trace future changes in the river biocenosis under the influence of man's activity.

Field investigations were conducted in the course of the streams lying at the highest altitude above sea level: the springs of the Olszowy Potok, the Poręba, and the Raba, 11 stations being determined there. The description of the investigation territory and the character of stations, dates and sampling methods were given in the paper by Szczęsny (1975). For the general information of the reader it should be recalled that the bottom of the River Raba — similarly as in the majority of the West Carpathian streams and rivers — is chiefly stony. In the middle part of the river (stations 2 to 8) it is composed for the most part of oval stones of not more than 10 to 30 cm in diameter; at the spring station (stations 0 to 1) flat stones of smaller sizes prevail, and in the section close to the

mouth (stations 9 and 10) the river bottom becomes more and more gravelly.

Detailed data on the character of the catchment basin and bed of the Raba and on the properties of the sediments of this river were given by Pasternak (1969 a, b) and Punzet (1969).

The majority of samples were fixed with 4 to 6 per cent formalin and only a few with ethyl alcohol.

The *Oligochaeta* material from stations 0, 1, 3, 5, 7, 9, was identified by K. Kasprzak and that from stations 2, 4, 6, 8, and 10 by B. Szczęsny.

Qualitative composition

58 species of *Oligochaeta* (Tabela I) belonging to 7 families were found in the samples from the River Raba. The most numerous were *Naididae* — 27 species, and *Enchytreidae* — 20 species. These families were also the most numerous in specimens. Species of the genus *Nais* (among which most numerous were *N. bretscheri* — over 40 000 individuals collected) and of the genus *Propappus* (the only species of the genus *P. volki* — over 8 500 specimens in the samples) proved to be the most numerous. It results from the existing observations concerning ecology of the genus *Nais* that species of this genus mainly inhabit stones where they live in a layer of overgrowing algae which serves them as a hiding place and for nutrition. The most numerous of these species, *N. bretscheri* and *N. alpina* (and also the less numerous *N. communis),* have no swimming ability and, in contrast to the other species of this genus, move only on the substratum by means of setae (Sperber 1950), which can be regarded as a sign of adaptation to life in the conditions of a water current. *P. volki* is a psammorheophilous species (Ude 1929, Szczepański 1954, Žadin 1964, Alimov 1968, and others).

Similar qualitative and quantitative relations in the fauna of *Oligochaeta* were found by Wachs (1967) in the River Fulda. Some differences observed in comparing the fauna of *Oligochaeta* in these two rivers mainly concerns species of the family *Tubificidae,* which are not numerous in the River Raba. The cause seems to lie in the fact that the River Raba is a much cleaner and far more stony river (a greater unit gradient) than the River Fulda, hence there are no proper living conditions for these species, such as a slimy or sandy substratum, and large amounts of organic matter. The River Fulda is, so far, the only river in Central Europe of a similar physiographical character whose *Oligochaeta* fauna has been examined in detail.

Tabela I. Lista gatunków skąposzczetów (Oligochaeta) rzeki Raby.
Oznaczenia: - 1-10; = 11-100; + 101-1000; ++ powyżej 1000 okazów

Table I. List of species of oligochaetes (Oligochaeta) of the River Raba.
Denotations: - 1-10; = 11-100; + 101-1000; ++ more than 1000 specimens

Stanowiska - Stations	0	1	2	3	4	5	6	7	8	9	10
Gatunki - Species											
Aelosoma sp. (hemprici Ehr.?)											-
Chaetogaster diaphanus (Gruit.)							-		-		=
- diastrophus (Gruit.)					=		=		-	-	
- limnaei Bret.									-		
Amphichaeta leydigi Taub.									=		
Paranais frici Hrabe									-		
Homochaeta setosa (Mosz.)											-
Uncinais uncinata (Örst.)										-	-
Ophidionais serpentina (Müll.)							=		-	=	+
Nais alpina Sperb.					+	+	+	=	+	=	++
- barbata Müll.	-					-		-		-	
- behningi Mich.							=		=		=
- bretscheri Mich.			-	-	+	+	++	+	+	=	++
- communis Pig.	+	-	-	-	=	-	+	-	+	=	++
- elinguis Müll.					-	=	++	=	+	-	++
- pardalis Pig.				-	+	+	+	+	-	-	++
- pseudobtusa Pig.					=	=	+		=	-	++
- variabilis Pig.											=
Slavina appendiculata (Od.)							-				
Vejdovskyella intermedia (Bret.)									-		
Stylaria lacustris (L.)									-	-	
Piguetiella blanci (Pig.)										-	-
Pristina bilobata (Bret.)						-		-			
- foreli (Pig.)					-		=	-	-	-	-
- idrensis (Sperb.)										-	
- longiseta Ehr.							-			-	
- menoni (Aiy.)					-	=	+	-	=	-	-
- rosea (Pig.)								-			
Pristina sp.										-	
Tubifex tubifex (Müll.)					-		=		-		=
Limnodrilus claparedeanus Rat.					-	-				-	-
- hoffmeisteri Clap.						-	=		=	=	+
- udekemianus Clap.							-		-		-
Tubificidae n. det.						+		=		+	
Aulodrilus pluriseta (Pig.)										-	-
Propappus volki Mich.	-	-	-		+	=	+	=	+	++	++
Cernosvitoviella atrata (Bret.)	-		-	-	-	-					
- carpatica Niels. et Christ.	-		=	=	-						
- immota (Knöl.)		-	-								
- tatrensis (Kow.)	-		-								
Cernosvitoviella spp.	-	-	=	=	-		-	-			-
Mesenchytreus armatus Lev.	=	=	-	=							
Mesenchytreus spp. (armatus ?)			=	-	-		-			-	
Henlea cf. heleotropha Steph.							-				
- perpusilla Friend.	-								-		
- similis Niels. et Christ.	=										
- ventriculosa (Udekem.)						-					
Henlea spp.		-	-	=	-						
Fridericia bulbosa (Rosa)			-				-				
- gracilis Bülov			-				-				
- maculata Issel.					-		-				
- ratzeli (Eisen)			-								
Fridericia spp.		-	-	=	-						
Enchytreus buchholzi Vejd.			-						-		
Enchytreus spp.					-		-		-		
Lumbricillus spp.		-	-				-				
Marionina argentea (Mich.)		-	-	-							
- communis Niels. et Christ.							-				
- riparia Bret.		-	-	-	-	-	-	-	-	-	-
- spicula (Leuck.)			-		-		-		-		
Marionina spp.			-		-		=		-	-	=
Enchytreidae n. det.	=	=		=		=		-		-	
Haplotaxis gordioides (Hart.)		-		-		-					
Lumbriculus variegatus (Müll.)					-			-	-		
Stylodrilus heringianus Clap.		-	-	-	-	-	-	-	=		
Lumbriculidae n. det.			-		-		-				-
Eiseniella tetraedra f. typica (Sav.)			-	-	-	-		-			
Dendrobaena rubida (Sav.)				-							
Dendrobaena spp.	-										
Lumbricidae n. det.	-	-		-		-					
Liczba gatunków Number of species	10	12	18	14	23	18	30	17	27	21	25

Distribution of *Oligochaeta* along the course of the River Raba

The numbers of oligochaetes found in hydrobiological samples from particular stations of the River Raba are presented in Table I with the use of symbols, a general orientation in the distribution of species along the river course being hence obtained. Two groups of stations with a similar faunistic composition of *Oligochaeta* can be distinctly seen in this table: these are stations 0 to 3 and 4 to 10. The sector of the stream which includes stations 0 to 3 is characterized by a fairly poor fauna of *Oligochaeta*, and therefore a not very large number of species — only 24 — and a strikingly small number of individuals. It is moreover characterized by the dominance of representants of the family *Enchytreidae* to which $^2/_3$ of the species belong, with a complete absence of representants of *Tubificidae*.

The sector including stations 4 to 10 has a rich fauna of *Oligochaeta*, both with regard to the number of species — over 50 — and individuals. It is, moreover, characterized by the dominance of representants of the family *Naididae*, an increasing number of *Tubificidae*, and only one species of the family *Enchytreidae — Propappus volki*.

For more detailed investigations of the problem of zonation among the oligochaetes percentage relations between particular species were

Tabela II. Skąposzczety (Oligochaeta) Raby w siedliskach o dnie kamienistym w warunkach prądowych. Udział procentowy form liczniejszych. Oznaczenia: A - sumy średnich ilości osobników na 2 l objętości podłoża z każdego poboru; B - ilość poborów; C - ilość osobników

Table II. Oligochaetes (Oligochaeta) of the River Raba in habitats of stony bottom in letic conditions. Percentage share of more numerous forms. Denotations: A - sums of mean numbers of individuals per 2 l volume of substratum from each sampling; B - number of samplings; C - number of individuals

Stanowiska Stations		0	1	2	3	4	5	6	7	8	9	10
Gatunki Species	A		9.6	26.6	16.2	215.8	111.6	1472.6	195.9	429.1	576.0	5682.4
	B	3	4	7	7	7	7	7	7	7	6	6
	C	454										
Chaetogaster spp.						0.5		0.1		0.2	0.07	0.2
Nais alpina						34.0	20.2	7.2	2.2	18.3	2.0	11.6
- barbata		0.9					0.2		0.2			
- behningi								0.4		0.2		0.9
- bretscheri				1.5		23.0	57.8	63.4	68.7	18.7	0.6	43.8
- communis		67.2	10.4	2.6	3.7	3.9	0.6	1.3	0.1	6.1	0.5	8.8
- elinguis						0.1	1.3	12.9	10.4	33.9	0.05	13.0
- pardalis						15.6	15.7	7.4	9.9	0.9	0.2	1.8
- pseudobtusa						0.6		5.2		1.4	0.2	2.4
- variabilis												0.5
Pristina spp.						0.1		0.5	0.2	1.1	0.4	0.01
Propappus volki		0.9	5.2			19.5	1.9	0.9	4.7	17.1	86.4	16.0
Cernosvitoviella spp.		1.8	6.2	54.9	24.7	1.0	0.2	0.01	0.1			
Mesenchytreus spp.		4.6	26.0	15.8	9.2	0.3		0.01				0.01
Henlea spp.		15.2	3.1									
Fridericia spp.			3.1		25.9	0.2						
Naididae		68.1	10.4	4.1	3.7	77.8	95.9	98.6	91.8	81.2	4.1	83.8
Tubificidae						0.3		0.1	0.4	1.3	9.4	0.6
Enchytreidae		30.8	76.2	85.4	92.3	21.5	4.1	1.2	6.4	17.3	86.5	16.0
Lumbriculidae			13.4	6.4	1.2	0.4		0.05	1.3			
Lumbricidae		1.1		4.1	2.3				0.1			

Tabela III. Skąposzczety (Oligochaeta) Raby w warunkach bezprądowych, podłoże zróżnicowane. Udział procentowy form liczniejszych. Oznaczenia: A - sumy średnich ilości osobników na 2 l objętości podłoża z każdego poboru; B - ilość porobów; C - ilość osobników; x - A. leydigi pojawiła się masowo tylko raz - 9.III.1970

Table III. Oligochaetes (Oligochaeta) of the River Raba in lenitic conditions, substratum differentiated. Percentage share of more numerous forms. Denotations: A - sums of mean numbers of individuals per 2 l volume of substratum from each sampling; B - number of samplings; C - number of individuals; x - A. leydigi appeared in masses only once - 9.III.1970

Stanowiska Stations		0	1	2	3	4	5	6	7	8	9	10
Gatunki Species	A		21.5	55.8	100.2	1434.5	450.5	3477.9	291.9	347.9	435.5	469.5
	B	3	4	7	7	6	7	7	7	7	6	6
	C	454										
Chaetogaster spp.						4.3		0.1		0.7		
Amphichaeta leydigi x										36.2		
Ophidionais serpentina								1.1		0.6	3.2	1.8
Nais alpina						13.7	14.9	3.1	5.3	11.9	2.5	3.8
- barbata		0.9									0.5	
- behningi								0.5		1.3		0.6
- bretscheri					3.0	41.8	59.4	39.4	82.0	15.9	1.0	1.1
- communis		67.2		1.8	0.6	0.8	0.4	1.7	0.7	2.0	3.2	21.7
- elinguis							0.3	45.3	1.0	17.6	0.6	1.5
- pardalis					12.0	32.7	15.7	3.0	5.0	0.2	0.4	0.4
- pseudobtusa						3.9	0.9	2.2		2.8	1.3	
Pristina spp.						0.1	1.0	0.8	1.6	1.9	0.6	1.3
Propappus volki		0.9				1.4	2.1	0.7	3.5	1.8	63.8	43.3
Cernosvitoviella spp.		1.8	6.0	64.3	56.1	0.4						
Mesenchytreus spp.		4.6	25.6	14.5	9.6	0.03		0.05				
Henlea spp.		15.2					0.2					
Naididae		68.1		1.8	15.6	97.2	93.2	97.3	95.5	91.6	14.5	33.1
Tubificidae							1.3	1.2	0.9	4.7	20.6	22.3
Enchytreidae		30.8	62.8	96.4	81.8	2.7	5.1	1.3	3.5	3.4	64.9	44.6
Lumbriculidae			2.3	1.8		0.03	0.2	0.2	0.1	0.3		
Lumbricidae		1.1	32.5		0.8		0.2					

calculated at successive stations for lotic and lenitic habitats counting per 2 l of the volume of the substratum mean numbers of individuals for each sample and for each of these habitats. The results for more numerous species or genera are shown in Tables II and III. From these Tables it results quite clearly that *Oligochaeta* do not show distinct zonation of occurrence with the course of the river as was found, e.g., with regard to *Trichoptera* in the River Raba (Szczęsny 1975) or earlier with respect to various faunistic groups inhabiting streams (Illies, Botosaneanu 1963). Wachs (1967) came to a similar conclusion when investigating *Oligochaeta* of the River Fulda. There is, however, a certain regularity visible in Tables I—III; at stations 0 to 3 (especially 1 to 3) *Enchytreidae* dominate, whereas at the other stations *Naididae* are prevalent. Ecological analysis of the species composition at individual stations shows, however, that $^2/_3$ of the species occurring in the stream sector including stations 0 to 3 are amphibiotic forms living in humid soil but also often encountered in aquatic environments. Representants of the following genera are among them: *Cernosvitoviella, Mesenchytreus, Henlea, Fridericia, Enchytreus, Lumbricillus, Eiseniella* and *Marionina. Aquatic* forms settling this sector are not numerous and belong to the species *Nais, Propappus* and *Stylodrilus.* The sector of stations 4 to 10 is settled mainly by aquatic forms, amphibiotic ones occurring only sporadically.

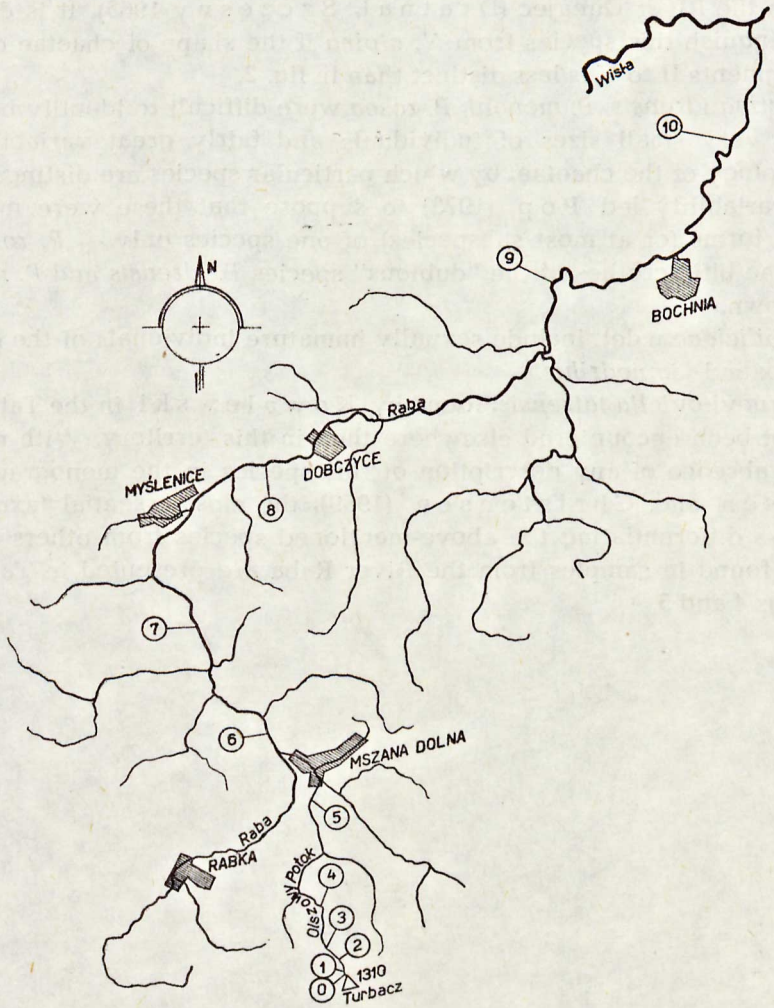
A fairly large participation of amphibiotic forms in samples from the upper sector of the stream should be explained by its character i.e.: a poorly developed stream bed, small depth of the water, a considerable unit gradient and consequent great erosion. These factors decide the character of the stream which could be determined as showing close contact between soil and water. The scarcity of aquatic forms in this sector is undoubtedly caused by an insufficiency of nutrition in the form of an epiphytic layer of algae on stones which fail to find there favourable development conditions owing to: poor light access (long lying snow-cover, north exposition of the slope, strong shading by the surrounding forest in a deep valley) and a lack of mineral salts.

A lack of distinct zonation in the distribution of *Oligochaeta* species along the course of the River Raba, or in other words no close dependence of *Oligochaeta* on the thermal conditions of the environment, which factor is decisive, as is well known, in zonation, is one of the characteristic features of this faunistic group. The majority of *Oligochaeta* species demonstrate a similar life course and great adaptation ability to a wide range of variations in the environmental conditions, only a few being characterized by a distinct ecological specialization (Moszyński, Moszyńska 1957).

Taking as a basis also Wachs' data (1967) from the River Fulda, *Nais alpina* and *N. pardalis* can be listed among species showing a poorly marked zonation of occurrence in the River Raba. Sperber (1950) and Wachs (1967) regard *N. alpina* as an oligostenothermic species (it occurred in abundance in the spring and in the sector close to the spring of the River Fulda together with *N. communis)*, whereas Brinkhurst (1967) does not ascribe to it these properties. It is worth noting that, in spite of a certain preference of the two mentioned species to higher situated stations, none of their individuals were found either in the spring (station 0) where *N. communis* was richly represented, or at stations 1 and 3. Numerous occurrence of *N. communis* in the springs and in lower sectors of the rivers can be explained by the fact that it is one of the most eurythermic species of *Oligochaeta*, this being indicated by Timm's (1972) experimental investigations.

Changes in the fauna of *Oligochaeta* along the course of the river with regard to the system of dominating forms as well as their abundance are distinctly connected with changes in the character of the substratum of the river and the "fertility" of the water, hence the inflow of biogenic substances originating from municipal sewage or fields under cultivation. Thus, a reduced bottom erosion (smaller gradient, a more stabilized and specifically developed bed of the stream) and the close neighbourhood of farm complexes at station 4 caused an increased abundance of *Naididae*, forms settling above all epiphytic associations of microphyte on

stones and feeding on them (W a c h s 1967, S z c z ę s n y 1974), and an increase in the abundance of *Propappus volki* — a psammorheophilous species. Similar fluctuations in the abundance of *Naididae* occurred at station 6 below Rabka and Mszana Dolna, at station 8 below Myślenice, and at station 10 below Bochnia. In the lower sector of the river, with an increase in participation of fine grained substratum in the bottom, a concomitant increase in settling on it of forms such as the above-mentioned *Propappus volki* and *Tubificidae* (W a c h s 1967, S z c z ę s n y 1974) takes place. The dependence of *Oligochaeta* on the substratum of the river is particularly clearly visible at station 9. In this part the



Ryc. 1. Teren badań
Fig. 1. Investigation territory

river bed of the Raba forms a poorly stabilized substratum of gravel and sand settled abundantly by *P. volki*, whereas lack of any greater stones causes a decrease in the abundance of *Naididae* (Tables II, III).

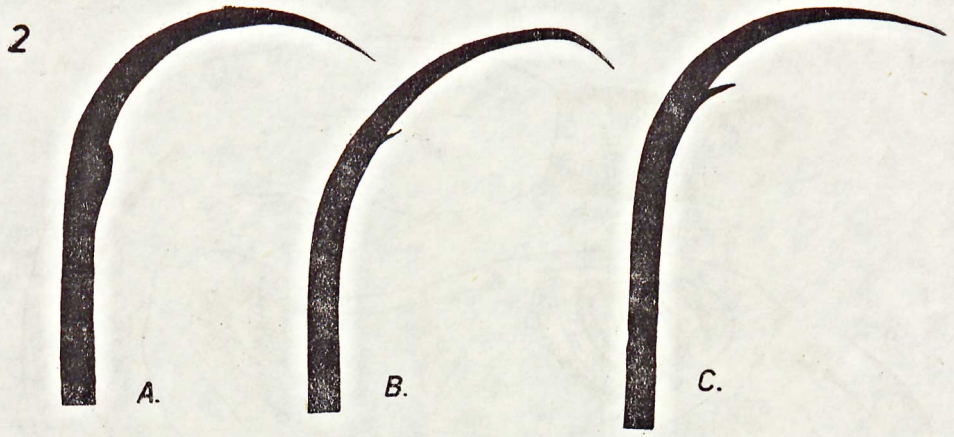
Zoogeographical and taxonomical remarks

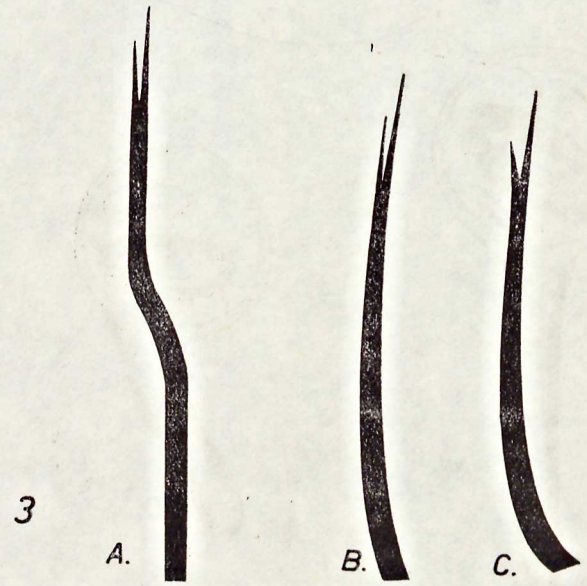
Nais behningi settles the rivers of Eastern Europe as well as the Danube (Čekanovskaja 1962); in Poland it has been found, so far, only in the River Dunajec (Dratnal, Szczęsny 1965). It is difficult to distinguish this species from *N. alpina* if the shape of chaetae of ventral segments II to V is less distinct than in fig. 2.

Pristina idrensis, *P. menoni*, *P. rosea* were difficult to identify because of the very small sizes of individuals and fairly great variability in morphology of the chaetae, by which particular species are distinguished. This variability led Pop (1973) to suppose that these were morphological forms (or at most subspecies) of one species only — *P. rosea*. In fig. 3 the bifid crothes of the "dubious" species *P. idrensis* and *P. menoni* are shown.

Tubificidae n.det. include sexually immature individuals of the genera *Tubifex* and *Limnodrilus*.

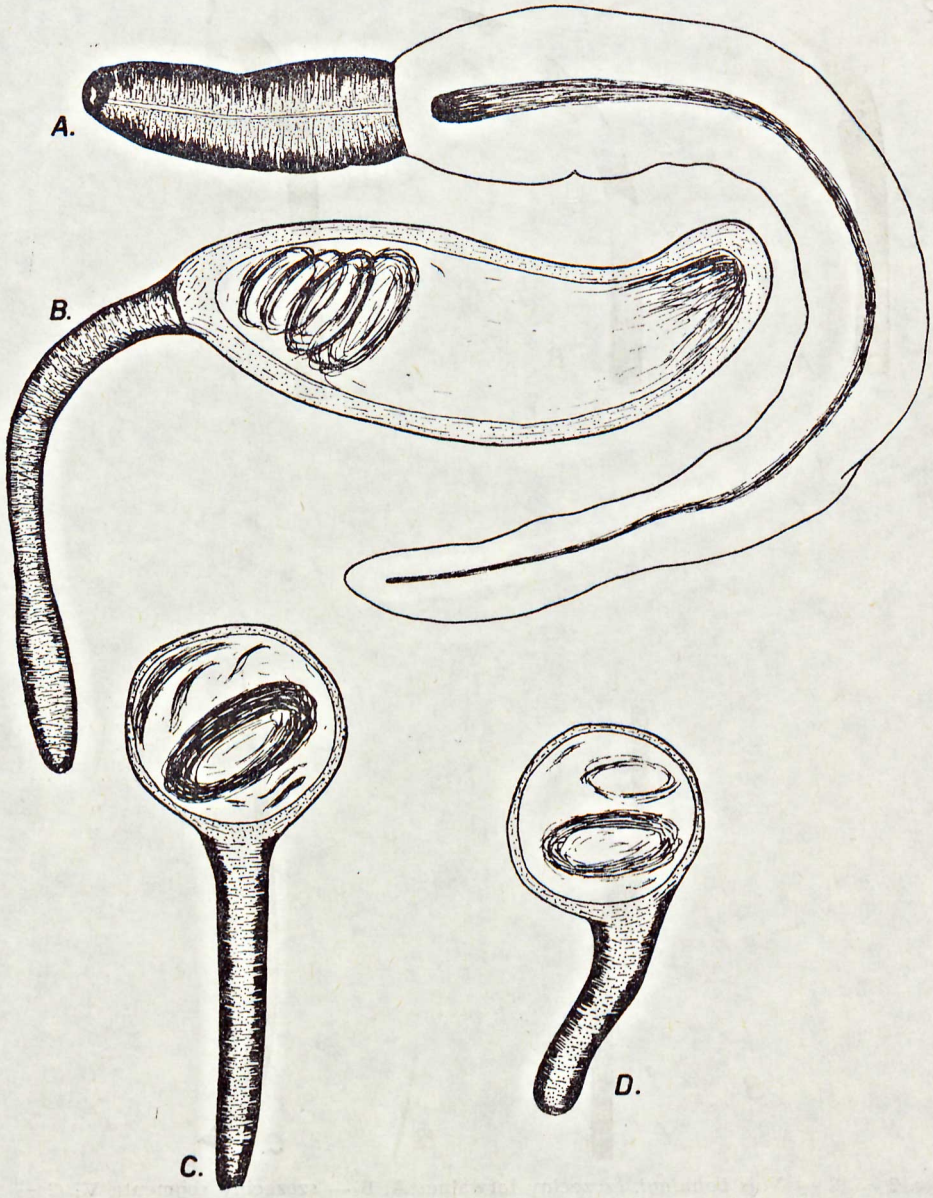
Cernovitoviella tatrensis, found by Kowalewski in the Tatra Mts has not been encountered elsewhere than in this territory. With respect to the absence of any description of this species in the monography by Nielsen and Christensen (1959), the most essential taxonomic features differentiating the above-mentioned species from others of this genus found in samples from the River Raba are presented in Table IV and figs 4 and 5.





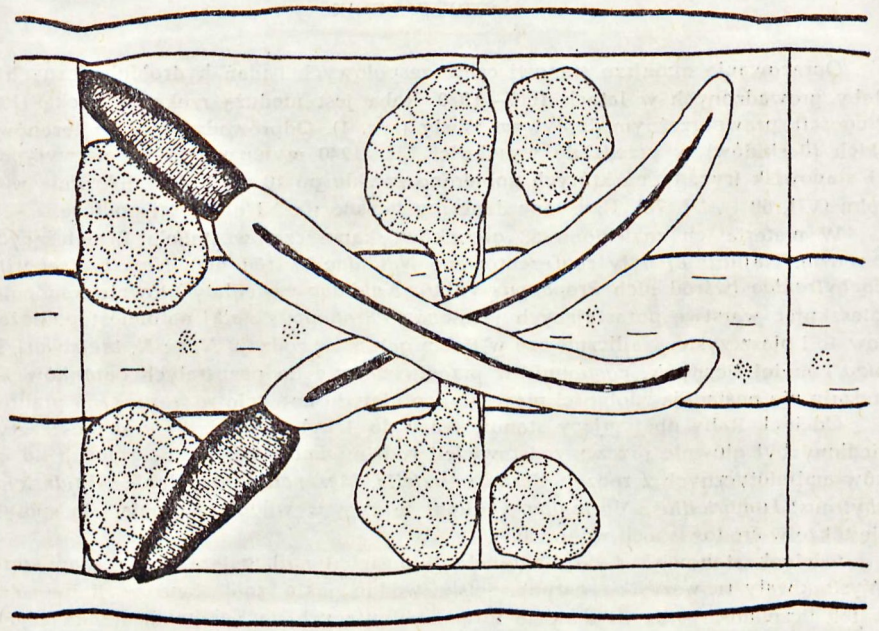
Ryc. 2—3. 2 — *Nais behningi*, szczeciny larwalne: A, B — szczeciny segmentu V; C — szczecina segmentu III; 3 — szczeciny igłowate: A — *Pristidina idrensis*, segment III; B — *P. menoni*, segment V; C — *P. menoni*, szczecina typu „*P. amphibiotica*"

Fig. 2—3. 2 — *Nais behningi*, larval chaetae: A, B — chaetae of segment V; C — chaeta of segment III; 3 — bifid crotches: A *Pristidina idrensis*, segment III; B — *P. menoni*, segment V; C — *P. menoni*, crotched type „*P. amphibiotica*"



Ryc. 4. Zbiorniki nasienne (receptacula seminalis): A — *Cernosvitoviella tatrensis*; B — *C. immota*; C — *C. carpatica*; D — *C. atrata*

Fig. 4. Receptacula seminalis: A — *Cernosvitoviella tatrensis*; B — *C. immota*; C — *C. carpatica*; D — *C. atrata*



Ryc. 5. Położenie zbiorników nasiennych (receptacula seminalis) u *Cernosvitoviella tatrensis*

Fig. 5. Situation of receptacula seminalis in *Cernosvitoviella tatrensis*

Tabela IV. Różnice w budowie i rozmieszczeniu zbiorników nasiennych (receptacula seminalis) u gatunków z rodzaju Cernosvitoviella Niels. Christ. występujących w Rabie

Table IV. Differences in build and position of spermathecae (receptacula seminalis) in species of the Cernosvitoviella Niels. Christ. genus occurring in the River Raba

Gatunek Species	Kształt ampuły Form of ampulla	Długość przewodu wyprowadzającego Length of spermathecal duct	Stosunek długości przewodu wyprowadzającego do średnicy ampuły Ratio of the length of spermathecal duct to the diameter of ampulla	Położenie zbiorników nasiennych w segmentach Position of spermathecae in the segments
Cernosvitoviella tatrensis	workowata saccate	krótki short	1 : 3.0-3.5	V - VI rzadko tylko V seldom only V
Cernosvitoviella immota	workowata saccate	długi long	1 : 1.0-1.5	V
Cernosvitoviella carpatica	kulista globular	długi long	2.0-3.0 : 1	V
Cernosvitoviella atrata	kulista globular	krótki short	1 : 1	V

STRESZCZENIE

Opracowanie niniejsze stanowi część zespołowych badań hydrobiologicznych rzeki Raby prowadzonych w latach 1967—1970. Raba jest niedużą rzeką karpacką (129 km długości), prawobrzeżnym dopływem Wisły (ryc. 1). Odprowadza wody z terenów górskich (Beskidów) w przedziale wysokości 185—1240 m n.p.m. Do badań wytypowano 11 stanowisk (ryc. 1), na których pobierano zwykle po 10 prób siedmiokrotnie w ciągu roku (VII. 69 — VI. 70). Uzyskane dane przeliczano na 2 l objętości podłoża.

W materiałach znaleziono 58 gatunków skąposzczetów (tabela I) należących do 7 rodzin. Najliczniej były reprezentowane *Naididae* (wśród nich *Nais bretscheri)* oraz *Enchytreidae* (wśród nich *Propappus volki*). *Naididae* zasiedlały głównie kamienie, zamieszkując warstwę porastających je glonów, *Propappus volki* natomiast podłoże żwirowate i piaszczyste. Najliczniejsze w Rabie gatunki z rodzaju *Nais: N. bretscheri, N. alpina* i mniej liczny *N. communis* w przeciwieństwie do pozostałych gatunków z tego rodzaju nie posiadają zdolności pływania, co ułatwia im życie w warunkach prądowych.

Odcinek Raby obejmujący stanowiska 0 do 3 był najuboższy w skąposzczety. Zasiedlony był głównie przez przedstawicieli rodziny *Enchytreidae*, należących do gatunków amfibiotycznych z rodzaji *Cernosvitoviella, Mesenchytreus, Henlea, Fridericia, Enchytreus, Lumbricillus, Marionina.* Gatunki te żyją w wilgotnej glebie, ale spotyka je się także w środowiskach wodnych.

Odcinek stanowisk 4 do 10 (tabela I) posiadał najbogatszą faunę skąposzczetów. Występowały tu wszystkie gatunki ściśle wodne jakie znaleziono w Rabie. Zmiany w ich liczebności oraz w układzie form dominujących na kolejnych stanowiskach pokrywały się wyraźnie ze stopniem „żyzności" wody, czyli dopływem substancji biogennych pochodzących ze ścieków miejskich bądź pól uprawnych oraz ze zmianami w charakterze podłoża rzeki. Obserwowano więc wzrost liczebności skąposzczetów na stanowiskach poniżej większych osiedli (tabele II, III) np. poniżej Rabki i Mszany — stanowisko 6, poniżej Myślenic — stanowisko 8, poniżej Bochni — stanowisko 10. Obserwowano też wzrost udziału form psammofilnych i pelofilnych *(Propappus volki, Tubificidae)* w faunie skąposzczetów na niżej położonych stanowiskach, wraz ze zwiększaniem się udziału podłoża drobnoziarnistego w dnie z biegiem rzeki.

Nie stwierdzono (tabele II, III) wyraźnej strefowości występowania skąposzczetów z biegiem rzeki, co wskazywałoby na brak ścisłej zależności skąposzczetów od termiki środowiska. Słabo zaznaczoną strefowość występowania wykazały jedynie *Nais alpina* i *N. pardalis.*

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ERRATA

Strona Page	Wiersz — Line: od góry from above	Wiersz — Line: od dołu from below	Zamiast — Instead of	Winno być — Ought to be
17	5		amount	amounts
23		beetwen 3/4		substances penetrate into surface waters. The intensity of the influence
23		12	peat, bogs	peat-bogs
26		12	Volldenweider	Vollenweider
32	1		casses	cases
36		8	Piaseczna	Piaseczno
36	18		the ground of minimum	the ground water surface of minimum
43	13		phytoplankto	phytoplankton
47		11	allio-	alloio-
48		12	of the immediate	of the initial area. For ground supply the present drainage basin is 9.4 percent of the immediate
53		14	(C_a/w)	$(C_a/\overline{W})$
54	11		differences	different way
56		17	$\frac{R_1.C_r.2400}{W}$ %	$\frac{R_1.C_r.2400}{\overline{W}}$ %
58	4	5	(C_a/w)	$(C_a/\overline{W})$
77				
tab. I	7		hemprici	hemprichi
82		11	crothes	crotches
83		1	crotched	crotchet
103	17		sprawn	spawn
115				
tab. 5				
kol. 6		27	30.5—30.0	30.5—39.0
116		13	$(\sigma\bar{x})$	$(\sigma_{\bar{x}})$