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**Makrofauna denną zbiornika zaporowego w Goczałkowicach
w latach 1965—1969**

**Bottom macrofauna in the Goczałkowice dam reservoir
in the years 1965—1969**

Mémoire présenté le 5 juin 1972 dans la séance de la Commission Biologique
de l'Académie Polonaise des Sciences, Cracovie

Abstract — Investigations of the bottom macrofauna of the dam reservoir at Goczałkowice were carried out from 1965—1969 as a continuation of those carried out from the beginning of its existence. In the years 1965—1967 a further decrease in the amount of bottom macrofauna was observed, but from 1968 there was a gradual increase. *Oligochaeta* and the larvae of *Chironomidae* (mainly *Procladius* and *Chironomus plumosus*) dominated quantitatively. The number of large *Mollusca*, mainly *Unio pictorum*, also increased. The upper and central zones were most numerously populated by the bottom macrofauna. Usually the encountered forms had already been noted in previous years.

The dam reservoir at Goczałkowice is situated 67 km below the source of the River Vistula. Its exploitation beginning in 1955, it is intended for retention and water supply for Silesia.

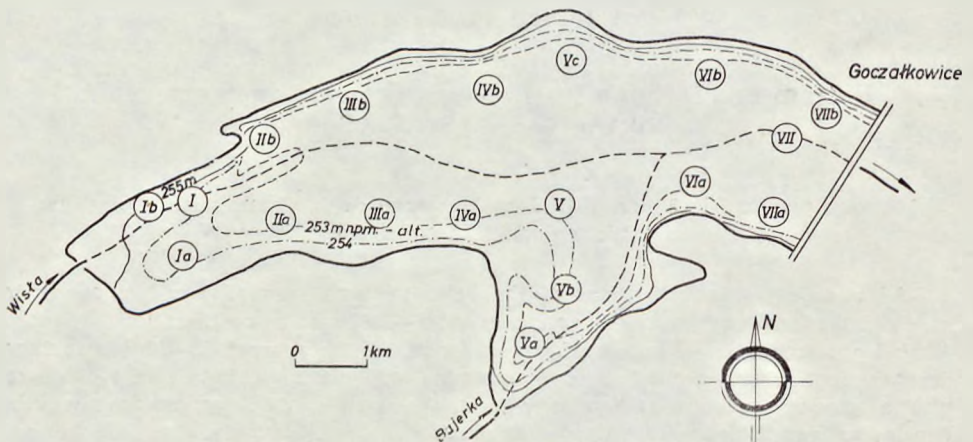
Parallel to other hydrological investigations, the changes in the composition of the bottom macrofauna have been observed from the beginning (Grzybowska, 1957, Kysela 1957, 1958a, 1958b, Zaciłchowska 1965a, 1965b, 1965c; Krzyżanek 1965, 1966, 1970).

The last work (Krzyżanek 1970) presented a detailed analysis of the bottom macrofauna in the years 1962—1964, discussed the process of the formation of the bottom macrofauna of the dam reservoir at Goczałkowice, and gave a synthesis of the results of previous investigations. The purpose of the present work was to discuss the composition of the bottom macrofauna in the years 1965—1969, as a continuation of the investigations begun by the author in 1961.

Methods of investigation and the characteristics of the stations

The samples were taken at permanent points situated in 4 zones of the reservoir (fig. 1). The upper zone covers the north-west (points Ib, IIb, IIIb, IVb) and the south-west (points Ia, IIa, IIIa, IVa) parts of the reservoir. The central zone includes the sampling points I, V, VII, and the zone of the bay of the River Bajerka, points Va and Vb. The lower part (at the dam) covers the north-east (sampling points Vc, VIb, VIIb) and the north-east part (points VIa, VIIa). The samples were taken 3 times in the year: in June, July, and September or October.

In 1965 the June samples were taken in the period before the



Ryc. 1. Rozmieszczenie stanowisk poboru prób na zbiorniku Goczałkowice

Fig. 1. Distribution of sampling points in the Goczałkowice reservoir.

reduction of the water level. In July and September, because of the low level of the water, the sampling points, especially VIa and VIIa, were situated nearer the central zone. The methods of sampling remained unchanged (K r z y z a n e k 1970). The results of physico-chemical analyses do not differ from those obtained in previous years and presented in previous works (K r z y z a n e k 1970). The temperature of the water in the investigated periods was between 10° and 25°C, the pH value being 7.5 to 8.0. Only in summer in the long periods of high day temperatures was an increase in the pH value to 8.5 observed, mainly in 1965 at a low water level. The sampling points were situated in places where the depth of the water was between 1.5 and 6.0 m. Only in the central zone, at point VII, did the depth reach 10 m. The bottom of the north-east zone of the reservoir was sandy or slimy and sandy. In other stations it was slimy or covered with decayed vegetation, mainly in the south-west part of the reservoir.

Particular attention was paid to the larvae of *Chironomidae*, the table of their specific composition being attached, as they continually show certain differences, especially qualitative ones. The remaining groups, whose composition showed insignificant qualitative changes, were elaborated only generally, the most important species being discussed in the text.

In 1965 the level of the reservoir was reduced by more than 1.5 m. The fall began in June, and the reservoir reached its lowest state of 252.85 m above sea level in August. This low water level was maintained till the end of that year. It was supposed that this would bring about the changes in the animal associations, chiefly in the drained part, especially as in this reservoir — except for periods of flood changes in the water level occurred rarely and were insignificant.

As a result of the fall in the water level in the reservoir in 1965 almost all the aquatic plants of the littoral part died out (K u f l i k o w s k i 1968). These plants decayed on the emerged parts and after a month the growth of land grasses and weeds was already observed on the uncovered territory. A fairly low water level was maintained till the end of 1965 and did not reach 254.0 m above sea level until February 1966.

In the first months of 1966 the water level continually rose, reaching 255.86 m above sea level at the end of May. After a slight fall in June, the water level was maintained between 254.30—255.0 m above sea level till the end of November. At the end of December a small rise up to 255.42 m above sea level occurred. In that year considerable changes in the composition of aquatic vegetation were noted (K u f l i k o w s k i 1968). Besides the disappearance of certain species such as *Myriophyllum verticillatum* and *Elodea canadensis*, an abundant development of *Rorippa amphibia* and, in the bay of the River Bajerka, of *Armoracia lapathifolia*, was observed. The majority of plants which had died out in the previous year reappeared, only the area of their occurrence being changed.

In 1967, after an initially high water level in the first months, the level was between 254.70—254.25 m above sea level from March to the end of December.

At the end of January 1968 the water level fell to 253.90 m above sea level, and was thus maintained till the end of March. From April to July it varied between 254.20 and 254.90 m above sea level. At the end of July a strong flood wave raised the level to the ordinate 255.90 m above sea level; from August to December a constant fall was observed, reaching 254.10 m above sea level in the last days of December.

In 1969 from January to the end of February the level of the reservoir was maintained at the rather low level of the ordinate 254.00 m above sea level. Beginning from March a continual rise in the water

level was observed, its maximum being reached in the middle of July — 254.80 m above sea level. This level did not significantly change till the end of the year, being within the range 254.20—254.80 m above sea level.

The general characteristics of the bottom macrofauna in the years 1965—1969

In summer 1965 on the uncovered area of the bottom of the reservoir, which extended over about 800 ha, large numbers of *Mollusca*, mainly of the genera *Unio* and *Anodonta* were scattered. Already from 1960 (Zacwilichowska 1965a) constant increase in the number of these molluscs had been observed and in later years especially in the north-east part of the reservoir (Krzyszak 1966).

The fall in the water level and the emergence of such a large area offered the opportunity of obtaining more detailed information about the numbers of these molluscs. On the whole area *Anodonta cygnea* predominated. This species was recorded for the first time in 1958 (Zacwilichowska 1965a) when one specimen was found in the north-east part of the reservoir. Later it was reported more and more often. In the upper eastern part of the reservoir the macrofauna was more numerous in June, while in the lower zone a richer macrofauna was observed in July and September. In 1965 the average density of population of the whole reservoir amounted to 1188 individuals/sq.m with a prevalence of the larvae of *Chironomidae*.

In 1966 the bottom macrofauna was less numerous, the average density of population amounting to 1025 individuals/sq.m. This mainly applied to the sampling points situated in the dam zone, especially in the south-east part. Only the upper and central parts of the reservoir showed numerous bottom macrofauna at certain periods. The larvae of *Chironomidae* with an average density of 658 individuals/sq. m., dominated, especially in the central zone. The greatest number of *Oligochaeta* were recorded in the upper zone (the south-west part) and in the central one, *Mollusca* being found in the north-west part.

In 1967 the bottom macrofauna was also poor, amounting to 1060 individuals/sq.m. on the average. This mainly applied to the sampling points situated in the south-west part of the reservoir, where the numbers of the bottom macrofauna did not exceed 500 individuals/sq.m. Also at the points where the bottom macrofauna had been previously more numerous (sampling points Ia, I, Ib), its numbers amounted to 1500 individuals/sq.m. only in some periods.

In 1968 a small increase in the bottom macrofauna, especially in *Oligochaeta*, occurred at almost all sampling points. The number of larvae of *Chironomidae* was almost identical with that of the previous

Tabela I. Skład ilościowy fauny dennej (okazów /m²) zbiornika Gosażkowiec w latach 1965-1969

Table I. Number of bottom fauna (indiv./sq. m.) in the Gosażkowiec Reservoir in the years 1965-1969

Grupy Groups	Strefa Zone Rok Year	A - Górna - Upper		B - Zatoka Zatoka Bay of River Bejerka	C - Centralna Central	D - Dolna - Lower	
		a) część północno- zachodnia North-Western section	b) część południo- wo-zachodnia South-Western section			a) część północno- wschodnia North-Eastern section	b) część południo- wo-wschodnia South-Eastern section
OGÓŁEM TOTAL	1965	942	972	1115	1203	1164	990
	1966	1184	945	1166	1137	806	687
	1967	1144	1097	1083	1188	821	962
	1968	1225	1229	1271	1775	1223	1223
	1969	2106	1292	737	2581	975	550
CHROMOMIDAE	1965	525	514	770	635	675	748
	1966	581	450	597	659	535	440
	1967	671	663	830	774	564	605
	1968	722	613	743	930	631	502
	1969	693	484	132	821	396	264
OLIGOCHAETA	1965	235	360	206	484	381	147
	1966	350	425	310	362	200	187
	1967	286	302	105	378	191	132
	1968	265	438	378	786	378	550
	1969	951	594	308	1687	359	242
MOLLUSCA	1965	99	40	37	49	49	59
	1966	114	33	41	28	35	16
	1967	36	59	-	11	33	28
	1968	60	56	9	3	9	115
	1969	60	66	33	-	29	22
INNE OTHERS	1965	84	58	102	34	59	37
	1966	137	37	218	55	37	44
	1967	151	99	148	28	44	198
	1968	178	122	140	56	135	57
	1969	401	149	264	73	191	22

year, with the dominance of the genus *Procladius*. Out of other groups of the bottom macrofauna frequently encountered were *Trichoptera*, *Hirudinea*, and *Mollusca*, especially in the upper zone of the reservoir.

The increase in numbers of the bottom macrofauna observed in the previous year at the sampling points in the dam zone in the south-east part, which had emerged in 1965, was even more pronounced in 1968.

In 1969 the investigations indicated an increase in the number of the bottom macrofauna in the central and upper zones and a decrease in the zone of the bay of the River Bajerka and in the dam zone. These changes were brought about mainly by *Oligochaeta* and the larvae of *Chironomidae*. Among the last named the pelophilous and predacious forms dominated.

In the years 1965--1969 among the most numerous groups of the bottom fauna were the larvae of *Chironomidae* (Table I). The specific composition of this group is presented in Table II. Besides *Chironomidae*, *Oligochaeta* were fairly numerous, especially in the central zone. The smallest numbers of *Oligochaeta* were recorded in the north-east and south-east part of the dam zone. The most frequently encountered species were *Tubifex tubifex*, *Tubifex* sp., *Limnodrilus hoffmeisteri*, and *Nais* sp. Besides *Oligochaeta*, considerable numbers of *Mollusca*, especially *Anodonta cygnea* and *Unio pictorum*, as well as small species of the genus *Pisidium* (*P. amnicum*, *P. subtruncatum*, *P. henslovanum*) also occurred, these last species mainly in the central zone, *Unio* being most often found in the north-east part.

Among the snails species of the family *Valvatidae* (*Valvata piscinalis*, *V. piscinalis* f. *antiqua*, *V. pulchella*, *V. naticina*), *Lymnaeidae* (*Radix limosa*, *R. auricularia*), and *Planorbidae* (*Planorbis planorbis*, *Planorbarius corneus*) were most frequently encountered.

Of the remaining groups of the bottom macrofauna only *Trichoptera* (*Polycentropus flavomaculatus*, *Limnephilus* sp., *Mystacides azurea*, *M. nigra*, *Cyrrnus flavidus*, and *Oecetis ochracea*), *Ceratopogonidae* (genera *Palpomyia* and *Stilobezzia*), *Hirudinea* (mainly *Helobdella stagnalis*, *Glossiphonia complanata*, and *Hemiclepsis marginata*), and *Ephemeroptera* (*Caenis* sp. and *C. moesta*) are worthy of note.

The various representatives of *Nematodes*, *Megaloptera* (*Sialis* sp.), and *Isopoda* (*Asellus aquaticus*) were encountered sporadically and mainly at a few littoral sampling points of the upper zone. Also the forms of the near-bottom layers were often found in the samples.

Discussion of the results

The present work deals with investigations of the bottom macrofauna in the years 1965--1969, which are the continuation of the faunistic investigations begun on the dam reservoir at Goczałkowice in 1955.

After initially small numbers of the bottom macrofauna in the years 1965—1967 an increase was observed from 1968, the average density of population of 1491 individuals/sq.m. being reached in 1969. This increase was not large in comparison with the amounts reached in the years 1958—1961 (Z a ć w i l i c h o w s k a 1965, K r z y ż a n e k 1970).

In all the investigated years the greatest numbers of the bottom macrofauna were noted at the sampling points of the central zone of the dam reservoir, where the bottom was covered with a thick layer of slime, and of the upper zone, especially of its north-west part. At some points in this zone the numbers amounted to over 3 000 individuals/sq.m. with dominance of the larvae of *Chironomidae*, mainly pelo- and phytophilous ones. Besides the larvae of *Chironomidae*, greater numbers of *Oligochaeta* and *Mollusca*, especially of the large molluscs populating the banks, were found. *Unio pictorum* was among the most frequently encountered species in the last years, while *Anodonta cygnea* was found more often in 1964—1965. This probably resulted from the fall in the level of the reservoir, (in summer 1965) which was followed by the emergence of an area of 800 ha. Many *Mollusca* died out then, mainly *Anodonta cygnea*.

The quantitative decrease in the macrofauna in the years 1965—1967 continued that observed already in 1964. Beginning from 1968, a quantitative increase occurred. All the phenomena of qualitative and quantitative changes were also observed in other dam reservoirs in different periods of intensification of the development of the macrofauna (M o r d u c h a j - B o l t o v s k i j 1961, J o f f e 1961, Z e l i n k a 1962).

In the dam reservoir at Goczałkowice the mass development of the bottom macrofauna occurred after its flooding, with a maximum between 1958—1961, i.e. between the fourth and seventh year of the existence of the reservoir (K r z y ż a n e k 1970), and with a decrease in the years 1964—1967. Beginning from 1968 an increase in the bottom macrofauna was again observed.

STRESZCZENIE

W pracy przedstawiono wyniki badań makrofauny dennej zbiornika Goczałkowice z lat 1965—1969. Chociaż zbiornik istnieje 15 lat, w dalszym ciągu obserwowano zmiany, zwłaszcza w gęstości wsiedlenia. Począwszy od 1961 r., kiedy to obserwowano maksymalny wzrost ilości makrofauny dennej, następował stopniowy jej spadek. Najniższe wartości przypadły w latach 1965—1967. Począwszy od 1968 r. obserwowano ponowny wzrost ilości makrofauny dennej w całym zbiorniku. Głównymi grupami makrofauny dennej były *Oligochaeta* i larwy *Chironomidae*, głównie *Procladius*, *Chironomus plumosus* i *Cryptochironomus defectus*. Z mięczaków licznie występowały *Unio pictorum* oraz *Valvata piscinalis*. Pozostałe grupy makrofauny dennej odgrywały większą rolę w składzie ilościowym jedynie w górnej strefie zbiornika, gdzie notowano największe zróżnicowanie gatunkowe.

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Tabela II. Skład procentowy poszczególnych gatunków Chironomidae w Zbiorniku Goczałkowice w latach 1965-1969
 Table II. Percentage of individual species of Chironomidae in the Goczałkowice Reservoir in the years 1965-1969

Strefa Zone	A - Górna - Upper					B - Zatoka rzeki Bay of River Bajerka					C - Centralna Central					D - Dolna - Lower									
	a) część północno- zachodnia North-Western section					b) część południowo- zachodnia South-Western section					a) część północno- wschodnia North-Eastern section					b) część południowo- wschodnia South-Eastern section									
Taksony - Taxons	Rok Year																								
	1965	1966	1967	1968	1969	1965	1966	1967	1968	1969	1965	1966	1967	1968	1969	1965	1966	1967	1968	1969	1965	1966	1967	1968	1969
<i>Microsectra curvicaornis</i> Tshern.								0.5										3							
<i>Tanytarsus</i> ex gr. <i>gregarius</i> Kieff.		0.5	1	2				2			1	2		20			1	2	1				1	3	2
- ex gr. <i>lauterborni</i> Kieff.											1		1												
- ex gr. <i>lobatifrons</i> Kieff.	2				3		1																3		
- ex gr. <i>manous</i> Wulp.	1		2	4		3	6	3	1	7	2		4								2	1	1	10	
<i>Cryptochironomus campolabis</i> Kieff.	2	1	0.5																						
- ex gr. <i>conjugens</i> Kieff.			4	4		1	3	8			2	2	2	6		1		1	17		2			8	6
- ex gr. <i>defectus</i> Kieff.	7	5	6	8	3	5	15	2	4	19	3	6	3	14	27	1	15	9	2		6	10	3	6	
- <i>fuscimanus</i> Kieff.	0.5	2	0.5	0.5				2								1	3		8	6					
- ex gr. <i>viridulus</i> F.				4					1																
- ex gr. <i>vulneratus</i> Zett.	2		1			1		0.5			1								1						1
<i>Cryptochironomus</i> sp.							0.5																		
<i>Einfeldia</i> ex gr. <i>carbonaria</i> Mg.	1		0.5													1									
<i>Endochironomus</i> ex gr. <i>dispar</i> Mg.				0.5		1																		1	
- ex gr. <i>tendens</i> F.		14		1		5	3		1															1	3
<i>Glyptotendipes</i> ex gr. <i>griepkoveni</i> Kieff.	1	3	0.5	5	1	4	0.5	1		20				1										2	2
<i>Limnochironomus tritonus</i> Kieff.	4			1		3	0.5	0.5								0.5								4	1
- ex gr. <i>nervosus</i> Staeg.	3	7	13	5		5	3		7		10	7		1							3	2	1	1	
<i>Microtendipes</i> ex gr. <i>chloris</i> Mg.	1	4	6	7	9	4			7					5											
<i>Pentapedilum exectum</i> Kieff.		1																						1	6
<i>Polypedilum brevipennatum</i> Tshern.						1										2									
- ex gr. <i>convictum</i> Walk.		1				2	0.5	1										4	7					3	
- ex gr. <i>nubeculosum</i> Mg.	2	1	8	7	2	2	8	2								0.5		1					4		6
<i>Xenochironomus xenolabis</i> Kieff.				2	1	1	1	1	1	1															
<i>Chironomus</i> f.l. <i>plumosus</i> L.	8	2	7	24	11	9	14	19	26	10	12	13	3	29	9	20	18	19	53	8	5	33	3	11	
- f.l. <i>semireductus</i> Lenz.							0.5	3																	
<i>Orthocladinae</i> non. det.																									
<i>Cricotopus</i> ex gr. <i>silvestris</i> Fabr.	2	4	4		9	1	0.5			4	1										3				1
- <i>brevipalpis</i> Kieff.							0.5																		
- ex gr. <i>algarum</i> Kieff.	0.5	0.5								19															
- <i>latidentatus</i> Tshern.																									
<i>Cricotopus</i> sp.																							1		
<i>Acricotopus lucides</i> Staeger		2															0.5								2
<i>Psectrocladius</i> ex gr. <i>palliopterus</i> Kieff.			2			5	5	1	1	2	2	3			2									7	8
<i>Diamesa gaedi</i> Mg.						1																			1
- <i>prolongata</i> Kieff.																0.5									
<i>Prodiamesa bathyphila</i> Kieff.			0.5					1																	
<i>Ablabesmyia</i> ex gr. <i>monilia</i> L.																									3
- <i>tetrasticta</i> Kieff.																									
<i>Pelopia punctipennis</i> Mg.	13		0.5	1		1												3							
- <i>villipennis</i> Kieff.									1																
<i>Frooladius</i> Skuze	64	40	55	40	44	47	46	56	43	21	48	67	75	48	44	69	51	62	54	38	76	69	87	67	79
Inne - Others		1																							19

ERRATA

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Table III				
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Table IV	1		w	z
218				
Table II	1		limnicznych	limnicznych, $n \cdot 10^3$
	4		reservoirs	reservoirs, $n \cdot 10^3$
223				
Table III	2		wodnego	wodnego, $n \cdot 10^3$
	4		environment	environment, $n \cdot 10^3$