

WOJCIECH KRZANOWSKI

**Zooplankton zbiornika zaporowego na Sole w Tresnej
w pierwszym roku jego istnienia****Zooplankton of the dam reservoir on the Soła at Tresna
in the first year after its construction**

Mémoire présenté le 7 décembre 1970 dans la séance de la Commission Biologique de l'Académie Polonaise des Sciences, Cracovie

Abstract — Complex hydrobiological investigations were carried out in 1966 in the newly constructed dam reservoir on the river Soła at Tresna, and in its suppliers and effluent. The investigations showed a fairly large differentiation of the reservoir with regard to the quality and quantity of the zooplankton. Its richest qualitative composition and most numerous occurrence was observed in the middle part of the reservoir, whereas in the upper part, receiving polluted waters of the river Soła, the zooplankton was much less differentiated and occurred in much smaller numbers. The dominant forms during the whole period of investigations were *Rotatoria* with the species *Polyarthra vulgaris* and *Keratella cochlearis cochlearis* and the genus *Synchaeta* preceding *Protozoa* and *Cladocera*. The majority of the zooplankton concentrated in the middle part of the reservoir and near the dam in layers of water 2.5 to 10 m deep. The composition and occurrence of the zooplankton in the Soła flowing out of the reservoir was similar to that observed in the deeper layers of water near the dam. The zooplankton in the suppliers was represented by a few species occurring sporadically.

Within the framework of a planned development of the basin of the river Soła (Mikulski 1963) at its entering a gorge through the Beskid Mały in the locality Tresna, a new dam reservoir was constructed in 1966 with a maximum capacity of about 100 mln m³ water and an area of about 1000 ha. This reservoir together with the lower lying ones at Porąbka and Czaniec forms part of the so-called cascade of the Soła, i.e. a complex of a series of reservoirs, connected regionally and closely co-operating with each other. The cascade is chiefly intended to regulate the flow of the Soła, owing to which the southern areas of Silesia will obtain a better supply of water and additional electric power.

In connection with the construction of this new water reservoir, the Laboratory of Water Biology in Cracow decided to carry out complex

hydrobiological investigations in the first year of its existence. Apart from hydrochemical investigations and those of bottom fauna, observations were made on the development of phyto- and zooplankton associations.

In connection with the completion of work on the hydrotechnical object itself (in 1966), a medium level of water was maintained in the reservoir throughout these investigations.

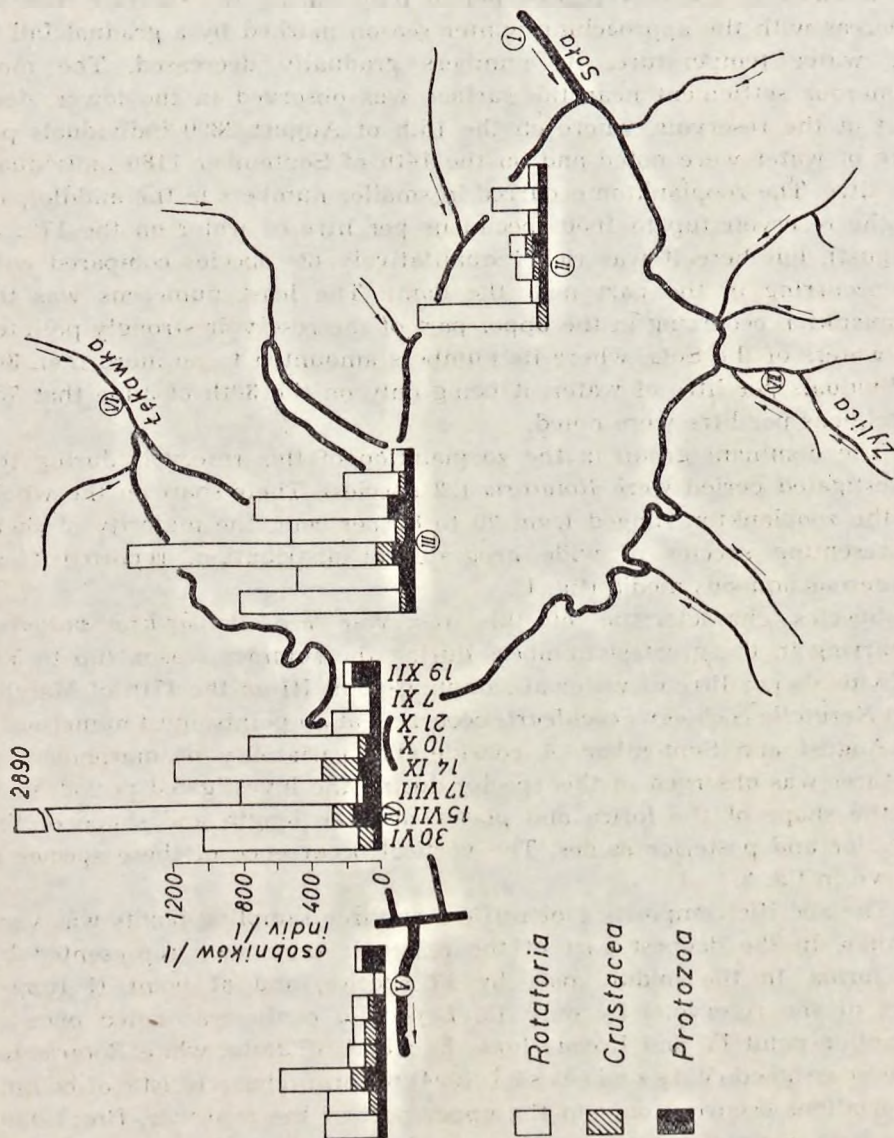
Samples were collected at three points: near the dam from a depth of 15 m (sampling-point IV), in the middle part of the reservoir from a depth of 7.5 m (sampling-point III), and in its upper part on the old bed of the Soła from a depth of 1.5 m (sampling-point II). Moreover, the material was collected from the Soła above the reservoir (sampling-point I), on the outflow from the reservoir (sampling-point V), and on its suppliers the streams Łękawka (sampling-point VI) and Zylica (sampling-point VII). The material was collected seven times from all sampling-points (on the 30th June, 15th July, 17th August, 14th September, 10th October, 21st October, and 7th November), but on the 19th December 1966 only from points I, IV, V, VI, and VII (fig. 1).

Samples in vertical sections were collected every 2.5 m of depth from the surface to the bottom (the first sample was collected from a depth of 0.3 m), only at sampling-point II being taken from a depth of 0.3 and 1.5 m. In this way at sampling-point II samples were collected from 2 levels, in the middle part of the reservoir from 3—4 levels, and near the dam from 6—7 levels, according to the state of the water level of the reservoir. From each of the suppliers and from the river Soła flowing out from the reservoir one sample was collected.

The material for quantitative analyses was obtained by concentrating 10 l of water to 100 ml using a plankton net of No 25 bolting cloth. The collected material was preserved in 4 per cent formalin solution. The number of organisms was counted in a Kolkwitz chamber of 1 ml volume and then calculated to 1 litre. In order to learn more exactly the qualitative composition of the zooplankton of this reservoir a number of surface tows were applied as well.

Horizontal distribution of zooplankton in the investigated period

With the water moving from the upper part of the reservoir towards the dam, hence with increasing depth, the character and composition of the zooplankton undergoes changes. Species encountered in the inflow but very seldom in the reservoir itself appear in great numbers. The rotifers occurring here are *Polyarthra vulgaris* and *Keratella cochlearis cochlearis*, or representatives of the genus *Synchaeta*. In contradistinction to the river where many bottom forms were found in the zooplankton, there develop in the reservoir typical plankton forms. Lacustrine forms, typical of open



Rys. 1. Poziome rozmieszczenie zooplanktonu w zbiorniku zaporowym na Sole w Tresnej w 1966 r. (ilość osobników/l). Na stanowiskach I, VI i VII notowano ilości zooplanktonu poniżej 1 osobnika/l

Fig. 1. Horizontal distribution of zooplankton in the dam reservoir on the Sole at Tresna in 1966 (number of individuals per litre). At sampling points I, VI, and VII the number of zooplankton noted was less than 1 individual per litre

waters, such as e.g. the rotifer *Filinia longiseta*, whose numbers amounted here to 830 specimens per litre of water, or the cladocer *Bosmina longirostris*, already appear in it.

In the surface layers of the reservoir zooplankton occurred more numerous in the investigated period only during the summer months, whereas with the approaching winter season marked by a gradual fall in the water temperature, its numbers gradually decreased. The most numerous settlement near the surface was observed in the lower, deep part of the reservoir, where on the 15th of August 2890 individuals per litre of water were noted and on the 14th of September 1180 individuals per litre. The zooplankton occurred in smaller numbers in the middle part of the reservoir (up to 1650 specimens per litre of water on the 17th of August), but here it was richer qualitatively (34 species compared with 30 occurring in the part near the dam). The least numerous was the zooplankton occurring in the upper part of the reservoir strongly polluted by waters of the Sola, where its numbers amounted to no more than 300 individuals per litre of water, it being only on the 30th of June that 750 specimens per litre were noted.

The dominant group in the zooplankton of this reservoir during the investigated period were *Rotatoria* (22 species). Their share in the whole of the zooplankton ranged from 20 to 82 per cent, the majority of them representing species of wide geographical distribution, reported from numerous aqueous media (fig. 1).

Species characteristic of this reservoir are *Polyarthra vulgaris*, occurring in the greatest numbers during the summer season (up to 590 individuals per litre of water at sampling-point III on the 17th of March), and *Keratella cochlearis cochlearis* occurring at all points, most numerous in August and September. A considerable variability of morphological features was observed in this species during the investigated period, such as the shape of the lorica and plates, and the length and shape of the anterior and posterior spines. The vertical occurrence of these species is shown in fig. 2.

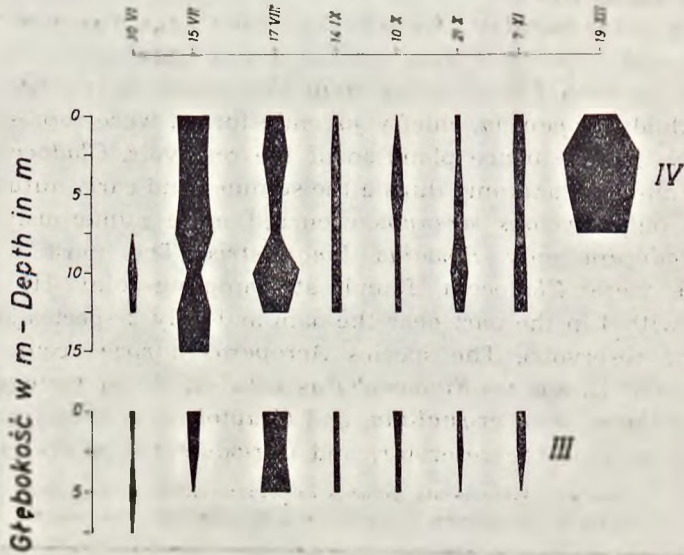
The specific composition of rotifers at three sampling-points was very similar. In the deepest part of the reservoir they were represented by 18 forms, in the middle part by 17 species, and at point II (upper part of the reservoir) by only 13. *Lepadella ovalis* was noted once at sampling-point IV and *Lecane luna*, *Euchlanis dilatata*, while *Rotaria rotatoria* assigned (Wiszniewski 1954) to forms characteristic of benthic associations occurred only in the upper part of the reservoir. *Brachionus angularis*, *Keratella quadrata*, *Ascomorpha saltans*, *Asplanchna priodonta*, *A. brightwelli*, *Anureopsis fissa*, *Hexarthra mira*, and *Diplois daviesiae* were noted only in the middle part of the reservoir and near the dam. The species *Filinia longiseta* occurred only during the summer season. In the middle part of the reservoir in the layers of water near the bottom its

numbers amounted to 830 individuals per litre of water. In June and July an increase in the number of rotifers' summer eggs was observed and in September and October of their resting winter eggs.

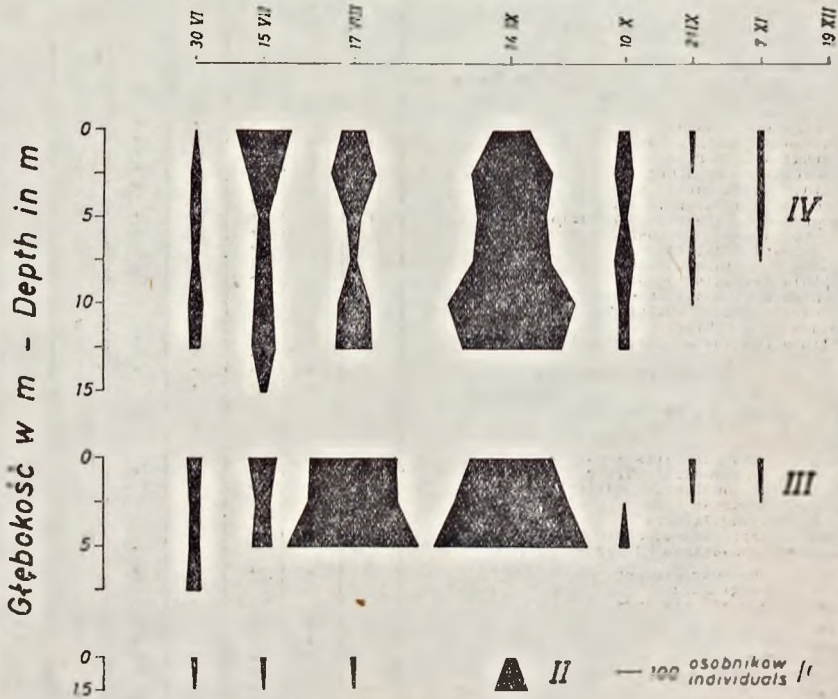
Of the plankton *Crustacea* yielding to rotifers in number of species and individuals, *Copepoda*, chiefly juvenile forms, were represented more numerous in the surface plankton of the reservoir. *Cladocera* occurred in smaller numbers and only during the summer and early autumn. Among *Copepoda*, only *Cyclops strenuus* occurred more numerous and from among *Cladocera* only *Bosmina longirostris*. The most qualitatively diversified were *Cladocera* found at sampling-point III (8 species compared with 4 in the part near the dam and only 2 species in the upper part of the reservoir). The species *Acroperus harpae* occurred only at sampling-point II, species *Simocephalus vetulus*, *Alona rectangula*, *Eurycerus lamellatus*, *Sida crystallina*, and *Graptoleberis testudinaria* only in the middle part of the reservoir, and *Ceriodaphnia pulchella* only near

Tabela I. Występowanie gatunków na poszczególnych stanowiskach
Table I. Occurrence of species at particular sampling points

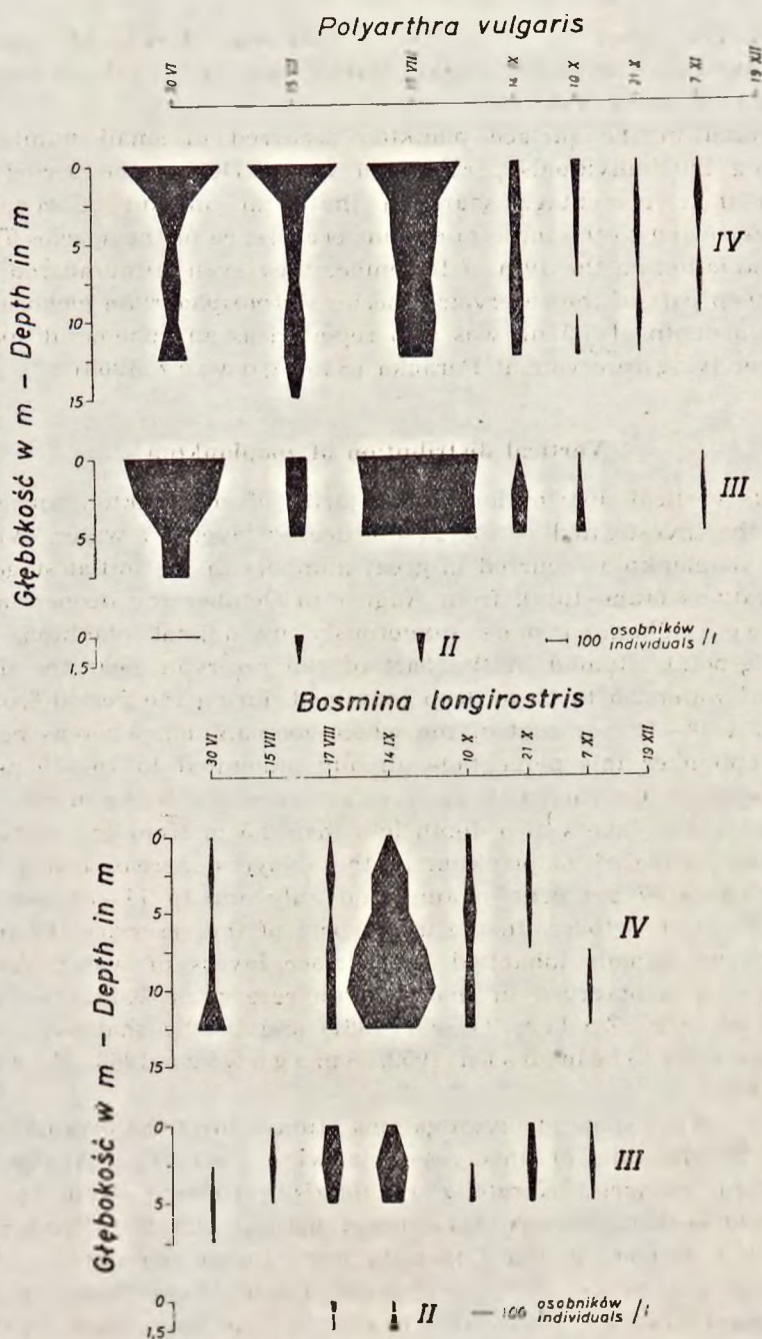
Gatunek Species	Stanowisko Sampling point	I	II	III	IV	V	VI	VII
<i>Diffugia corona</i> Perty				+			+	
<i>Actinosphaerium eichhorni</i> Ehrenberg				+	+			
<i>Tintinnidium fluviatile</i> Kent		+	+	+	+	+		
<i>Tintinnopsis lacustris</i> Entz			+	+	+	+		
<i>Carchesium</i> sp.			+	+	+			
<i>Epistylis plicatilis</i> Ehrenberg			+	+	+			
<i>Vorticella nebulifera</i> Müller				+	+	+		
<i>Rotaria rotatoria</i> (Pallas)			+					
<i>Trichocerca capucina</i> (Wierzejski et Zacharias)			+					
<i>Ascomorpha saltans</i> Bartsch		+		+	+	+		
<i>Asplanchna priodonta</i> Gosse				+	+	+		
- <i>brightwelli</i> Gosse				+	+	+		
<i>Synchaeta longipes</i> Gosse		+	+	+	+	+		
- <i>grandis</i> Zacharias			+	+	+	+		+
- <i>pectinata</i> Ehrenberg		+	+	+	+	+		+
<i>Polyarthra vulgaris</i> Carlin		+	+	+	+	+		
<i>Brachionus angularis</i> Gosse				+	+	+		
<i>Keratella cochlearis cochlearis</i> (Gosse)		+	+	+	+	+	+	+
- <i>tecta tecta</i> (Gosse)				+	+	+		
- <i>quadrata</i> (Müller)				+	+	+		
<i>Anuraopsis fissa</i> (Gosse)				+	+	+		
<i>Diplois daviesiae</i> Gosse				+	+			
<i>Euchlania dilatata</i> Ehrenberg			+					
<i>Lepidella ovalis</i> Müller					+			
<i>Lecane luna</i> (Müller)			+				+	
<i>Filinia longicaeta</i> (Ehrenberg)			+	+	+	+		
<i>Hexarthra mira</i> (Hudson)				+	+			
<i>Conochilus hippocrepis</i> Ehrenberg			+	+	+	+		
<i>Collotheca</i> sp.			+	+	+			
<i>Sida crystallina</i> Müller				+				
<i>Daphnia cucullata</i> Sars				+	+			
<i>Simocephalus vetulus</i> Müller				+				
<i>Ceriodaphnia pulchella</i> Sars				+	+			
<i>Bosmina longirostris</i> Müller			+	+	+	+		
<i>Eurycerus lamellatus</i> (Müller)			+	+				
<i>Acroperus harpae</i> Sars			+					
<i>Alona rectangula</i> Sars				+				
<i>Graptoleberis testudinaria</i> Fischer				+				
<i>Chydorus sphaericus</i> Müller					+	+		
<i>Cyclops strenuus</i> Fischer			+	+	+	+		
- <i>lilljeborgi</i> Sars				+	+			
<i>Paracyclops affinis</i> Sars					+			
ova		+	+	+	+	+	+	+
nauplius		+	+	+	+	+	+	+
kopepodit		+	+	+	+	+	+	+
Nematodes		+	+	+	+	+	+	+
Oligochaeta		+	+	+	+	+	+	+
Hydracarina		+		+	+	+	+	
Ostracoda				+	+			

Tintinnidium fluviatile

0
15] — 100 osobników / i
individuals / i

Keratella cochlearis cochlearis

0
15] — 100 osobników / i
individuals / i



Ryc. 2. Pionowe rozmieszczenie poszczególnych gatunków w zbiorniku zaporowym na Sole w Tresnej na stanowiskach II, III i IV

Fig. 2. Vertical distribution of the particular species in the dam reservoir on the Soła at Tresna at sampling points II, III, and IV

the dam. The occurrence of the species *Sida crystallina* in the open water zone provides, evidence of its mass development in the littoral zone (Ziegelmeier 1940) (Table I).

Protozoa in the surface plankton occurred in small numbers, not exceeding 150 individuals per litre of water. During the period of late autumn their percentage share in the total amount of zooplankton increases, owing to the more numerous occurrence of the species *Tintinnidium fluviatile*; on the 19th of December they even outnumbered rotifers in the deep part of the reservoir. Species *Actinosphaerium eichorni*, noted once at a depth of 7.5 m, was also reported as an ephemeral species of the lower lying reservoir at Porąbka (Smagowicz 1963).

Vertical distribution of zooplankton

In its vertical distribution the majority of zooplankton concentrated during the investigated period in the deeper layers of water. While the surface zooplankton occurred in great numbers in the initial stage of the investigations (June-July), from August to October the deeper layers of water were inhabited more numerous by animal plankton. At the sampling-point situated in the part of the reservoir near the dam the layers of water 2.5 to 10 m deep contained during the period from June to August 44—62 per cent of the whole zooplankton, whereas beginning from September this percentage already amounted to 76—79 per cent. The zooplankton occurred in the greatest numbers in the middle part of the reservoir in layers of a depth less than 2.5 m from the surface. The percentage share of zooplankton in these layers increased still further, amounting to 67 per cent in June and July and to 74—89 per cent in September and October. In the upper part of the reservoir the majority of plankton animals inhabited the surface layers of water. A similar phenomenon is observed in shallow dam reservoirs (Kiseleva 1954, Czapiak 1958, Žadin, Gerb 1961) and in the shallower parts of deep reservoirs (Siem'ińska 1952, Smagowicz 1963, Krzanowski 1965).

In the initial stage of investigations (June—July) the prevailing forms in the zooplankton of this reservoir were rotifers with the species *Polyarthra vulgaris*, *Keratella cochlearis cochlearis*, and the genus *Synchaeta* as dominants. A numerous occurrence of rotifers' summer eggs was noted. *Cladocera* and *Copepoda* were found sporadically. A more numerous occurrence of the protozoan *Tintinnidium fluviatile* (fig. 2) was observed in July, while later, beginning from September, its numbers decreased, increasing again in December. In August there occurred in the middle part of the reservoir a mass development of the rotifer *Filinia longiseta* (up to 830 individuals per litre of water). Beginning from September the number of rotifers *Polyarthra vulgaris* decreased, whereas

Keratella cochlearis cochlearis became more numerous. Genus *Synchaeta* continued to occur in large quantities and the rotifer *Collotheca* sp. appeared, encountered in great numbers, till November. It was only in this period that the rotifer *Brachionus angularis* occurred in small numbers. The cladocer *Bosmina longirostris* grew more and more numerous (fig. 2). Of the Protozoa occurring in this period *Tintinnopsis lacustris* and *Carchesium* sp. were encountered in fairly large numbers. The latter form was characterized by a rapid development and subsequent decrease in the number of colonies; from the end of October it occurred only sporadically.

The amount of zooplankton markedly decreased in October in the part of the reservoir near the dam, where the mean for the whole vertical amounted to only 280 individuals per litre of water, whereas in the middle part of the reservoir it reached a maximum of 2960 individuals per litre of water. *Rotatoria* with the forms *Keratella cochlearis tecta tecta*, *Synchaeta* sp., and *Collotheca* sp. continued to prevail, while among *Cladocera* only *Bosmina longirostris* and *Chydorus sphaericus* were noted sporadically.

In November, with the fall in water temperature and a sudden inflow of turbulent waters from the Soła, the number of plankton animals and the diversity of their species abruptly decreased. Among *Rotatoria* no more than a few species were noted, only *Asplanchna brightwelli* reaching a number of up to 180 specimens per litre of water in the part of the reservoir near the dam. A marked decrease in the number of rotifers' eggs was also noted. *Cladocera*, *Copepoda*, and *Protozoa* were found only sporadically.

In December, owing to the more numerous occurrence of the species *Tintinnidium fluviatile* (up to 370 specimens per litre of water), protozoans prevailed, whereas the representatives of the other systematic groups were noted only sporadically.

Zooplankton of the affluents and effluent of the reservoir

The qualitative and quantitative composition of the zooplankton of the river Soła below the dam at Tresna is comparatively very poor. This is related with the way in which the water is released from the reservoir, and thus with the location of the outlets within the limits of the dam. During the period of investigation the water was released only through undersluices; it contained, therefore, the least quantities of plankton animals. The interrelations of the individual groups and even species in the particular seasons in the river Soła, flowing out from the reservoir, were very much the same and often even identical with those prevailing during this period in the bottom parts of the reservoir near the dam.

The zooplankton of the river Soła above the reservoir at Tresna and

of the streams Żylica and Łękawka flowing into the reservoir itself was represented by only a few sporadically occurring species (Table I). This was related with the considerable pollution of the Soła above the reservoir and with the mountainous character of the streams Żylica and Łękawka. In the Soła inflow only species of rotifers were encountered, such as *Polyarthra vulgaris* and *Keratella cochlearis*, or representatives of the genus *Synchaeta* prevailing at that time in the reservoir itself, and a few representatives of *Protozoa*. No representatives of the other groups of plankton animals were noted in these suppliers.

STRESZCZENIE

W 1966 roku na nowo powstałym zbiorniku zaporowym na Sole w Tresnej przeprowadzono kompleksowe badania hydrobiologiczne na trzech stanowiskach oraz donośnikach i odpływie z tego zbiornika.

Badania wykazały dość duże zróżnicowanie w składzie jakościowym i ilościowym zooplanktonu, między dolną i środkową a górną częścią zbiornika. Zbiornik w rejonie cofki, narażony na wpływające zanieczyszczone wody Soły, wykazywał wyraźnie uboższy skład jakościowy i ilościowy. Największe zróżnicowanie gatunkowe obserwowano w środkowej jego części, gdzie zanotowano w dniu 10 października najwyższe średnie zasiedlenie dla całego poziomu, bo wynoszące 2960 okazów na 1 l wody.

Dominowały prawie przez cały czas badań *Rotatoria* z gatunkami *Polyarthra vulgaris*, *Keratella cochlearis cochlearis* i rodzajem *Synchaeta*. Mniej licznie występowały *Protozoa* i *Cladocera*, a przedstawiciele *Copepoda* spotykano nielicznie i głównie w głębszych warstwach środkowej i dolnej części zbiornika. Ogółem oznaczono 42 gatunki zwierząt planktonowych.

Większość zooplanktonu gromadziła się w środkowej i przyzaporowej części zbiornika w warstwach wody od 2,5 do 10 m głębokości, natomiast w rejonie cofki największe skupienie zwierząt planktonowych notowano bliżej powierzchni. Zooplankton powierzchniowych warstw wody występował liczniej na początku badań (czerwiec—lipiec), natomiast głębsze warstwy były zasiedlane obficie przez zwierzęta planktonowe w okresie od sierpnia do września. Skład jakościowy i ilościowy zooplanktonu Soły poniżej zapory w Tresnej był stosunkowo ubogi, a wzajemne stosunki pomiędzy grupami, a nawet gatunkami były zbliżone do tych, jakie panowały w tym okresie w warstwach przydennych przyzaporowej części zbiornika. Zwierzęta planktonowe donośników zbiornika reprezentowały tylko nieliczne gatunki spotykane sporadycznie.

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Adres autora — Author's address

mgr Wojciech Krzanowski

Zakład Biologii Wód, Stacja Hydrobiologiczna, Goczałkowice-Zdrój, pow. Pszczyna