

LUCJA KRZECZKOWSKA-WOŁOSZYN

**Zooplankton stawu karpiego pozostającego  
pod kilkuletnim zalewem**

**The zooplankton of a carp pond under  
conditions of continuous filling**

Mémoire présenté le 8 novembre 1971 dans la séance de la Commission Biologique de l'Académie Polonaise des Sciences. Cracovie

**Abstract** — The effect of several years' filling of the fish pond in Golysz (district Cieszyn) on the development of zooplankton was investigated. Seasonal variations and the influence of the fish stock on the quantity and qualitative composition of zooplankton were also discussed.

The most intensive development of zooplankton was found in the first year of the investigations, due to the first filling and utilization of the pond after its renovation. Permanent filling of the pond in the following years resulted in decreased amounts of zooplankton animals.

Fish ponds, when, as is usual, they are dried for winter, lose the vegetal and animal life that has developed in them. However, in spring filling of the pond restores the conditions for rapid resettlement (Gurzęda 1954, Odum 1963, Grygierek 1966, Starmach 1969). Odum (1969) reported that the number of species increases with the age of a pond, while biocenotic production (net) decreases. A simple and expedient way of avoiding it is to drain the pond and fill it again periodically; biocenosis is thus maintained in its early (young) successive stages. After the filling of new or rebuilt ponds there is a dynamic development of all populations, leading to domination of the environment (Ivlev 1933, Odum 1957). It is well known that new ponds or those refilled after an interval yield much better than permanently filled ones (Stegman 1952, Škorbatov 1954, Radzimovskij 1955, Starmach 1963, Krzeczowska-Wołoszyn 1966, 1967, a, b, Starmach 1969). According to some authors, even two-year ponds present a less favourable

environment for the development of different trophic levels than one-years ones (Grygierek, Wolny 1965, Wójcik-Migala 1965).

The aim of the present work was to investigate the effect of several years' filling of a pond on the development of zooplankton biomass.

The investigations were carried out in the carp pond „Kolejowy” of the Experimental Fishery Farm at Gołysz, district Cieszyn, continuously filled in the years 1958—1965. No samples were collected in the year 1960. In all other years samples were collected every 4—7 days. In the period from April 1960 to April 1964 the pond was not stocked. In the years when it was stocked with fish, it was drained only for taking fish (1 day).

Each time 50 litres of water were drawn (10 litres from five places in the pond) and strained through a No 20 plankton net. The quantitative samples were counted in a 0.5 ml Kolkwitz chamber; the calculation of the biomass was based on the data given by Morduchaj-Boltovskoj (1954), Starmach (1955), and Klimczyk (1957). All data were calculated for 1 litre of water. Data concerning the utilization of the pond are presented in Table I, the qualitative composition of zooplankton in Table II, the dynamics of dominant quantities in fig. 1, and the total quantity and biomass of the zooplankton in fig. 2.

Tabela I. Dane dotyczące użytkowania stawu „Kolejowy”  
(pow. 1.5 ha, średnia głębokość 1 m)  
(zestawił mgr inż. J. Matlak)

Table I. Data concerning the utilization of the pond „Kolejowy”  
(surface 1.5 ha, average depth. 1 m)  
(after J. Matlak)

Zarybienie Stocking	Odlów Fishing	Pasza Fodder	Nawożenie Fertilization
VII 1958 Karp przesadkowy KB Carp from first transfer pond (alevins) 3000 szt. specimens	IV 1959 K <sub>1</sub> Carp fry (fingerlings) 2150 szt. specimens 120 kg.		
IV 1959 Karp KA z tarliska nr 5 Carp from spawning pond No 5 6700 szt. specimens	IV 1960 K <sub>2</sub> Carp fry (fingerlings) 2470 szt. specimens 155 kg.	Lubin Lupins 2.1 g	
IV 1964 Selekty karpia R6A Carp selects (for breeders) Population (family) No 6A 139 szt. specimens	X 1964 137 szt. specimens 171 kg.		
X 1964 Selekty karpia R6A Carp selects (for breeders) Population (family) No 6A 137 szt. specimens	X 1965 135 szt. specimens 400 kg.	Lubin Lupine 7.0 g	Wapno Limestone 20 g (przed zarybieniem) (before stocking)

### Qualitative composition, quantity, and biomass

*Rotatoria* prevailed in the investigated pond. The dominant species were usually *Keratella cochlearis* and *Polyarthra vulgaris*; only in the year 1958 was *Conochilus unicornis* more numerous than *Keratella cochlearis*. *Cladocera* were less diversified but the variability of dominants was more pronounced. In the year 1958 *Ceriodaphnia* and *Diaphanosoma*, in 1961 *Daphnia longispina*, in 1962 *Ceriodaphnia* and *Bosmina*, in 1963 *Scapholeberis mucronata* and *Polyphemus pediculus*, and in 1964 and 1965 *Bosmina longirostris* prevailed. Among *Copepoda* were found small numbers of *Diaptomidae* and much more numerous *Cyclopidae*, whose larval stages (nauplii) prevailed. Some species (eg. *Camptocercus rectirostris*, *Graptoleberis testudinaria*, *Testudinella patina*) were encountered occasionally in the course of the investigations, while some were recorded only once (eg. *Squatinella tridentata*).

It was found that in the qualitative as well as quantitative composition of the investigated zooplankton *Rotatoria* were generally predominant. The peak of their development usually occurred in summer, when they constituted from 45 (July 1962) to 89 per cent (July 1968) of the whole zooplankton. Their maximum number was recorded at the beginning of April, 1958, but they were often encountered in great numbers in other seasons of the year: in 1962 the average monthly numbers of *Rotatoria* were almost three times greater in November than in July.

Sometimes the numbers of *Rotatoria* were smaller or equal to those of *Cladocera* or *Copepoda*. *Cladocera* dominated in July 1963 (the average was 79 per cent), in August 1964 (69 per cent), and in June 1965 (65 per cent). Their greatest numbers were observed at the end of August 1958.

*Copepoda* dominated in autumn, winter, or spring. Though their absolute number was not great, they formed a high percentage of the investigated zooplankton (up to 95 per cent of all animals in April 1965). Usually their larval stages (nauplii) were encountered.

*Rotatoria* though, occurring in great numbers, did not prevail in the biomass. The dominant species were usually *Cladocera*, characterised by considerable body size and individual weight.

The greatest development of zooplankton, and thus its greatest biomass, was recorded in the first year of the investigations.

The maximum share of *Rotatoria* was noted in July and August 1958. The monthly averages never exceeded 50 mg/litre, though at different times the biomass of *Rotatoria* was often greater, attaining its maximum on July 7<sup>th</sup>, 1958, at 145 mg/litre.

The maximum average value calculated for *Cladocera* was 257 mg/litre.

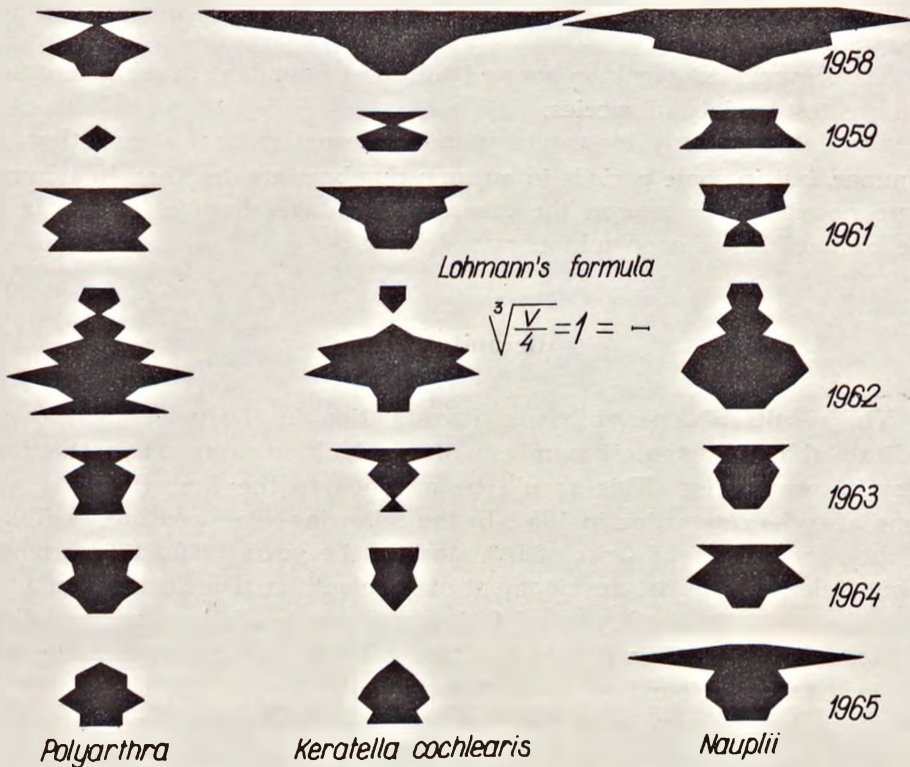
The absolute maximum, amounting to 330 mg/litre was reached on August 21<sup>st</sup>, 1958.

A similarly great biomass was observed at that time for *Copepoda*, which appeared in large numbers.

Tabela II. Skład jakościowy zooplanktonu  
Table II. Qualitative composition of zooplankton

Taksony Taxons	lata years	1958	1959	1961	1962	1963	1964	1965
<i>Carchesium</i> sp.				+				
<i>Codonella lacustris</i> Entz.		+		+	+	+	+	+
<i>Diffugia limnetica</i> Levander					+		+	+
<i>Halteria grandinella</i> (Müller)					+	+		
<i>Tintinidium</i> sp.					+			
<i>Vorticella</i> sp.		+	+	+	+			
Protozoa n. det.		+	+	+	+			
<i>Anureopsis fissa</i> (Gosse)		+	+	+		+	+	+
<i>Asplanchna priodonta</i> Gosse				+	+			
- <i>brightwelli</i> Gosse				+	+			
<i>Asplanchna</i> sp.		+	+	+	+	+	+	+
<i>Brachionus angularis</i> Gosse		+	+	+	+	+	+	+
- <i>calyciflorus</i> Pallas		+	+	+	+	+	+	+
- <i>rubens</i> Ehr.								+
<i>Brachionus</i> sp.					+	+	+	
<i>Cephalodella</i> sp.					+			
<i>Conochilus unicornis</i> Rousselet		+						
- <i>hippocrepis</i> (Schrank)		+						
<i>Conochilus</i> sp.			+	+	+	+	+	+
<i>Diplois daviessiae</i> Gosse		+						
<i>Euchlania dilatata</i> Ehr.		+	+	+			+	
<i>Filinia longiseta limnetica</i> Zacharias				+				+
- <i>longiseta</i> (Ehr.)		+		+	+	+	+	+
<i>Hexarthra mira</i> (Hudson)				+	+	+	+	+
<i>Keratella cochlearis</i> (Gosse)		+	+	+	+	+	+	+
- <i>var. tecta</i> (Gosse)		+		+	+	+	+	+
- <i>quadrata</i> (O.F. Müll.)		+		+	+	+	+	+
<i>Lecane flexilis</i> (Gosse)				+	+	+	+	+
- <i>luna</i> (O.F. Müll.)		+	+	+	+	+	+	+
- <i>lunaris</i> (Ehr.)		+		+	+	+	+	+
<i>Lepadella ovalis</i> (Müll.)				+	+	+	+	+
- <i>patella</i> Müll.		+		+	+	+	+	+
<i>Notbolca</i> sp. div.		+	+	+	+	+	+	+
<i>Polyarthra eurypetra</i> Wisrzejski				+	+	+	+	+
- <i>major</i> Burckhardt		+		+	+	+	+	+
- <i>vulgaris</i> Carlin			+	+	+	+	+	+
<i>Synchaeta</i> sp. div.				+	+	+	+	+
<i>Squatinella tridentata</i> (Fresenius)				+	+	+	+	+
<i>Testudinella patina</i> Hermann		+	+	+	+	+	+	+
<i>Trichocerca cylindrica</i> (Jennings)		+	+	+	+	+	+	+
- <i>pusilla</i> (Jennings)				+	+	+	+	+
<i>Trichocerca</i> sp.		+		+	+	+	+	+
<i>Trichotria pocillum</i> Müll.				+	+	+	+	+
- <i>truncata</i> (Whitelegge)				+	+	+	+	+
<i>Rotatoria</i> <i>jaja</i>		+	+	+	+	+	+	+
<i>Rotatoria</i> n. det.		+	+	+	+	+	+	+
<i>Acroperus harpae</i> Baird						+	+	+
<i>Alona</i> sp.							+	+
<i>Alonella exigue</i> Lilljeborg		+	+	+	+			
<i>Alonella</i> sp.					+			
<i>Bosmina longirostris</i> O.F. Müll.		+	+			+	+	+
<i>Ceriodaphnia</i> sp. div.		+	+	+	+	+	+	+
<i>Camptocercus rectirostris</i> Schoedler		+		+	+	+	+	+
<i>Chydorus sphaericus</i> O.F. Müll.		+	+	+	+	+	+	+
<i>Chydoridae</i> n. det.				+	+	+	+	+
<i>Daphnia longispina</i> Müll.		+	+	+	+	+	+	+
- <i>magna</i> Straus				+	+	+	+	+
- <i>pulex de Geer</i>					+	+	+	+
<i>Diaphanosoma brachyurum</i> Liéven		+	+	+	+	+	+	+
<i>Graptoleberis testudinaria</i> Fischer				+	+			
<i>Peracantha truncata</i> O.F. Müll.								+
<i>Pleuroxus</i> sp.		+	+	+	+	+	+	+
<i>Polypheims pediculus</i> Linné		+		+	+	+	+	+
<i>Scapholeberis mucronata</i> O.F. Müll.		+		+	+	+	+	+
<i>Sida crystallina</i> O.F. Müll.				+	+	+	+	+
<i>Cladocera</i> (juv.)		+		+	+	+	+	+
<i>Cladocera</i> n. det.		+	+	+	+	+	+	+
<i>Copepoda</i> (juv.)		+	+	+	+	+	+	+

\* - obecność taksonu  
presence of taxon



Ryc. 1. Zmiany ilościowe ważniejszych gatunków (średnie miesięczne)  
 Fig. 1. Quantitative changes of more important species (mean monthly)

### Seasonal variations

In comparing the zooplankton in the years 1958—1965 it may be said that the greatest amounts occurred in the first year of observation. This is especially true of the summer and autumn period, when peaks of zooplankton development, chiefly of rotifers, occur.

Winter zooplankton was poor, both quantitatively and qualitatively. Even though not numerous in absolute numbers, the rotifers were usually dominant, more rarely *Copepoda*, mainly larvae. In winter as well as in early spring some taxons, such as *Keratella cochlearis*, *K. quadrata*, *Polyarthra*, *Synchaeta*, eggs of *Rotatoria*, *Cyclopidae*, and their larval stages (nauplii), were mainly observed.

The spring plankton was characterized by a greater variability of species and greater numbers of rotifers, cladocerans and larval stages of *Copepoda*. The occurrence of *Lecane luna* and some species of the genera *Brachionus*, *Trichocerca*, *Asplanchna*, *Cephalodella*, *Diaphanosoma*, *Ceriodaphnia* and *Chydorus*, was also noted. The occurrence of cold-water

stenotherms of the genus *Notholca* in these two seasons of the year should be stressed.

The summer zooplankton showed the most abundant development and the greatest variety of species.

The total amount of zooplankton was smaller in autumn than in summer, but in some periods in autumn numbers greater than in summer were noted. In this season the greater percentage share of *Copepoda* in the composition of zooplankton was striking.

### Recapitulation

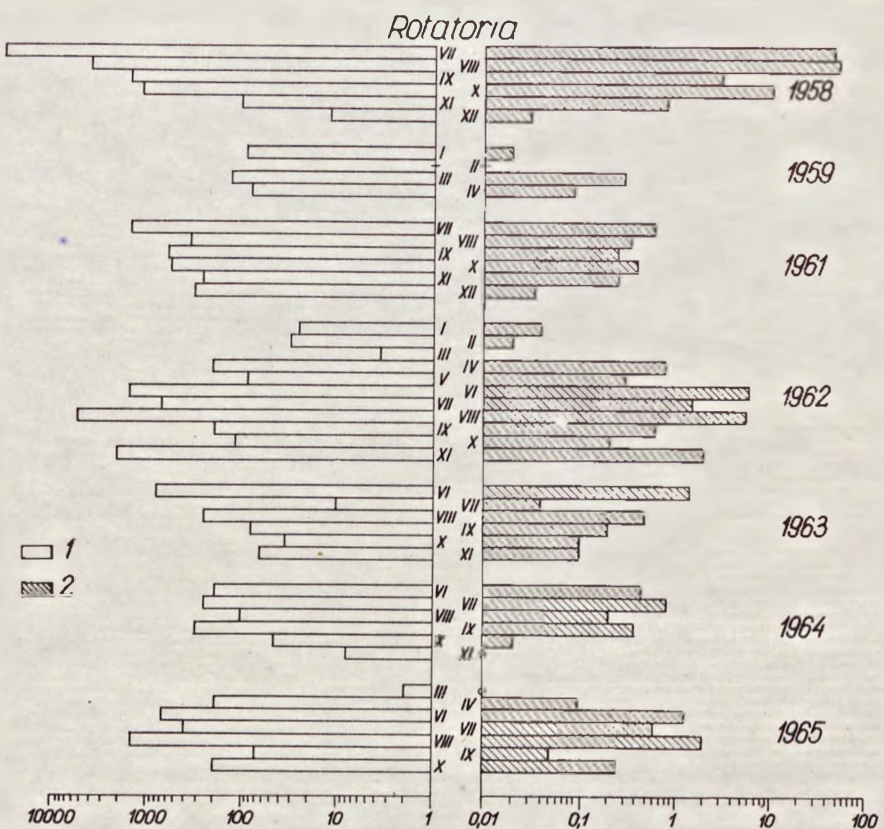
The results of a seven years' investigation in the pond „Kolejowy” indicate that the greatest numbers of zooplankton occurred in the first year of observation. This should be ascribed to the first filling of the pond after its renovation in 1957. In the following years continuous filling of the pond and the absence of fish stock in the years 1960—1964 brought about a decrease in the development of zooplankton. The smallest amounts were found in the sixth year of filling and the fourth year without fish.

According to Grygierek (1962, 1965), greater quantities of crustaceans were found in ponds densely stocked with fish than in those lacking or having very small amounts of fish with or without plant feeding of the fish. The same author observed that together with an increase in density of fish stock there occurred an increase in species of small body size and a decrease in species of large body size. Hilbricht-Ilkowska (1966) also states that „the abundance and percentage share of many species of rotifers depend on the density of the fish stock in ponds stocked for shorter as well for longer periods”.

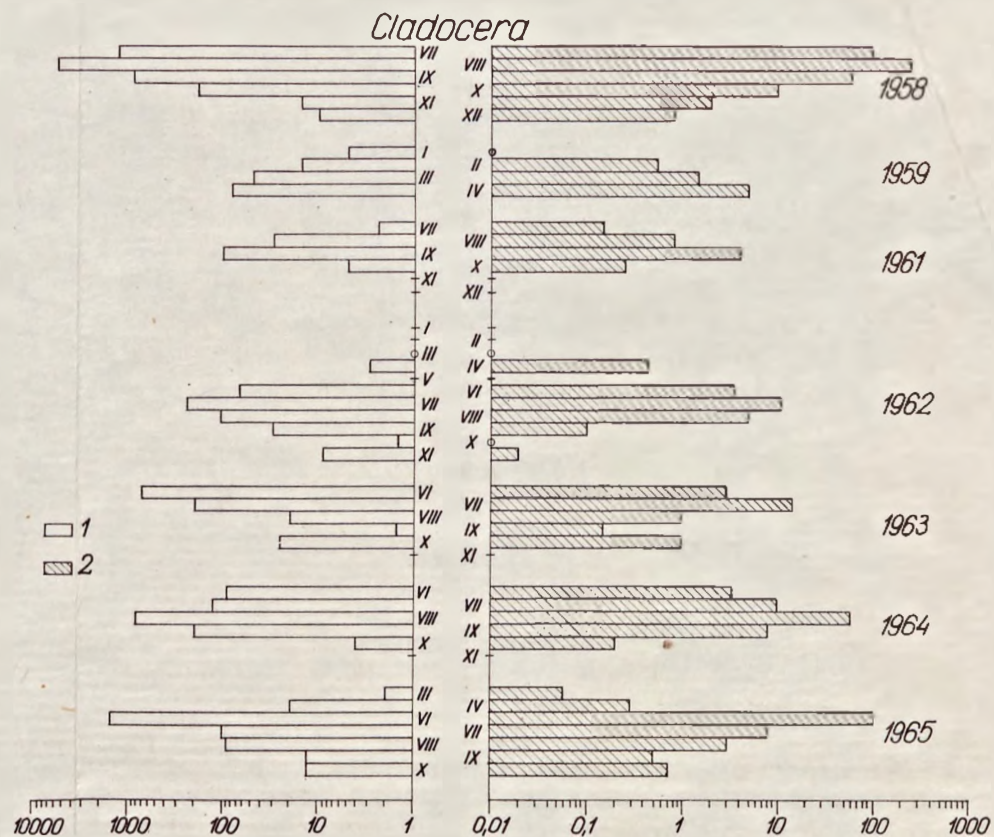
Wunder 1949, Gurzęda 1960, Schäperclaus 1961 also observed that disappearance from the environment of large species of some cladocerans takes place the more rapidly the greater was the fish stock.

The present investigations also confirm indirectly the conclusions of other investigators concerning the influence of fish stock on the quantity and qualitative composition of the zooplankton. This was indicated by the increased number of plankton animals in the pond „Kolejowy” in the years 1964 and 1965 after stocking, as compared with the former period without fish. In the years with fish stock *Cladocera* of smaller body size dominated, while in the years without fish there was a tendency for larger forms to develop.

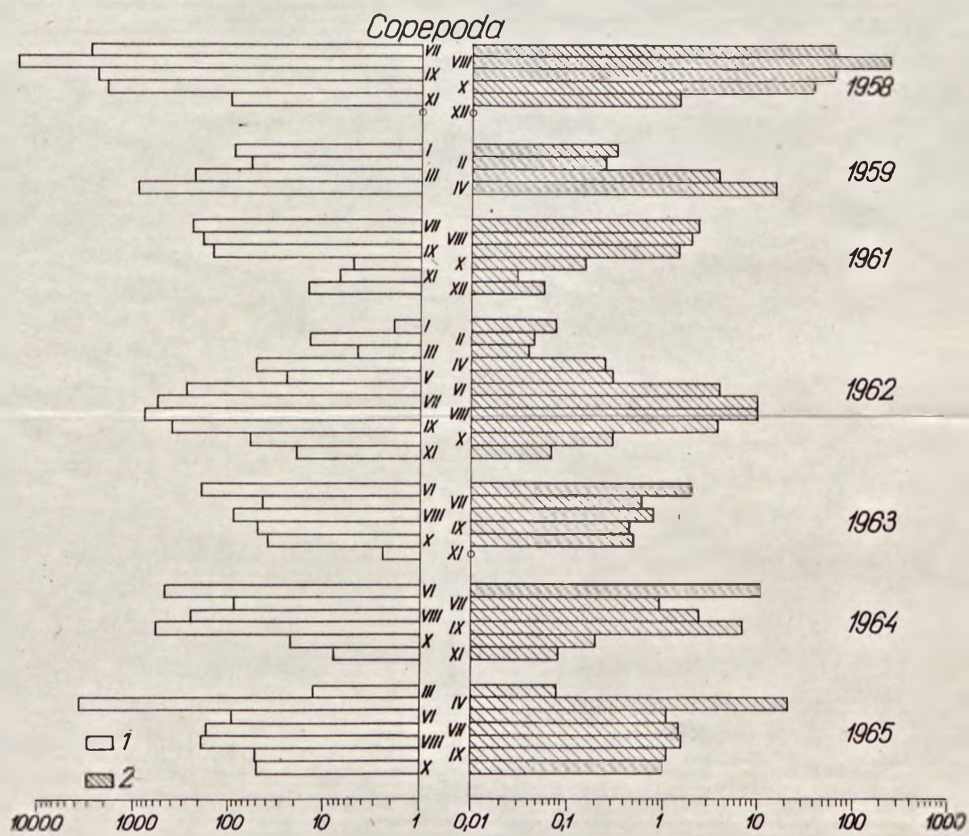
When comparing the zooplankton in the investigated pond with that in the ponds of the Golyz complex drained for winter, no significant qualitative or quantitative differences were found. The occurrence of some cold-water stenotherms in the pond „Kolejowy” is understandable as the



a



b



c

Ryc. 2. Liczebność (1 — osobników/litr) i biomasa (2 — mg/litr) (średnie miesięczne) poszczególnych grup zooplanktonu. — brak okazów lub biomasy, ○ ilość osobników < 1 lub biomasa < 0,01  
 Fig. 2. Quantity (1 — individuals/litre), and biomass (2 — mg/litre) (mean monthly) of particular groups of zooplankton. — lack of specimens or of biomass, ○ number of individuals < 1 or biomass < 0,01

pond was continuously filled. The number of zooplankton in the investigated pond differed in the course of the observations, but it lay basically within the range recorded for various fish ponds (Klimczyk 1964, Fereńska 1965, Fereńska, Lewkowicz 1966, Bucka, Kyselowa 1967).

It should also be noted that the favourable conditions of permanent filling of the pond „Kolejowy” caused a mass development of *Elodea canadensis*, which overgrew the pond from the bottom to the surface. This species if not in mass amounts, is considered to be favourable. However, very rapid growth of water-thyme exhausts the environment and decreases the development of plankton and the number of animals in ponds. It is also known that in utilized waters vegetation consisting of many species, which do not decompose at the same time, is more favourable.

In the investigated pond the decomposition of water-thyme after warm periods brought about an active development of bacteria. The common occurrence of *Beggiatoa* sp. usually found in anaerobic environments, seemed to indicate the decomposition of organic matter. It should be stressed that it was particularly often observed in the year 1963, mainly in samples collected in September.

#### STRESZCZENIE

Badania niniejsze dotyczą wpływu ciągłego zalania odrostowego stawu karpiego „Kolejowy” w Golyszu (powiat Cieszyn) na rozwój zooplanktonu.

Obserwacje prowadzono w latach 1958—1965, z tym że w 1960 roku prób nie pobierano. W latach 1960—1964 staw pozostawał bez obsady, w pozostałych latach opuszczano go tylko w czasie odławiania (1 dzień).

Dane dotyczące użytkowania stawu przedstawia tabela I, skład zooplanktonu tabela II, dynamikę liczebności dominantów ryc. 1, ogólną liczebność i biomasę zooplanktonu ryc. 2.

Zarówno w składzie jakościowym, jak i ilościowym zooplanktonu przeważały zwykle *Rotatoria*. Natomiast o jego biomasie decydowały przeważnie gatunki *Cladocera*, o dużych wymiarach i ciężarach jednostkowych.

Najobfitszy rozwój i największą różnorodność gatunków wykazywał zooplankton letni, ze szczególnie wzmocnionym rozwojem *Rotatoria*, po nich *Cladocera*. W jesieni ogólna ilość zwierząt planktonowych była mniejsza, przy czym uderzający był większy udział procentowy *Copepoda*, w zestawieniu z pozostałymi grupami. Zooplankton zimowy był bardzo ubogi tak w składzie, jak i liczebności. Plankton wiosenny charakteryzował większe zróżnicowanie gatunkowe oraz większą liczebność wrotków, wioślarek i larw widłonogów.

Rozpatrując całość zooplanktonu stwierdzono największą jego ilość w pierwszym roku badań (1958 r.). Wiązało się to zapewne z pierwszym zalaniem i eksploatacją stawu po jego przebudowie w 1957 roku. Ciągłe zalanie stawu w latach następnych, z równoczesnym brakiem obsady od 1960 do 1964 roku wpłynęło na spadek ilości zooplanktonu. Najmniejszą jego ilość notowano w 1963 roku — szóstym stałego zalania stawu, a czwartym pozostawienia go bez obsady rybnej.

Niniejsze badania potwierdziły też pośrednio wnioski innych autorów odnośnie wpływu obsad ryb na liczebność i skład zooplanktonu. Wskazywałby na to wzrost



ilości zwierząt planktonowych w latach 1964 i 1965, po wpuszczeniu ryb, w porównaniu do wcześniejszego okresu bez obsad.

Obserwowano w nim również przewagę występowania niektórych gatunków wioślarek o mniejszych wymiarach w latach z obsadą ryb, natomiast tendencję występowania większych ich form w czasie pozostawiania stawu bez ryb.

Porównując zooplankton omawianego stawu z zooplanktonem innych osuszanych na zimę stawów Zespołu Gołysz, można stwierdzić, że nie wykazuje on istotnych różnic jakościowych, względnie ilościowych.

#### REFERENCES

- Bucka H., K. Kyselowa, 1967. Plankton wybranych stawów karpowych w Gołyszu i Landeku — The plankton of selected carp ponds at Gołysz and Landek. *Acta Hydrobiol.*, 9, 339—380.
- Fereńska M., 1965. Zooplankton stawu rybnego „Księży” w Gołyszu — Zooplankton of fish pond „Księży” in Gołysz. *Acta Hydrobiol.*, 7, 59—70.
- Fereńska M., S. Lewkiewicz, 1966. Zooplankton stawów na tle niektórych czynników chemicznych — Zooplankton in ponds in relation to certain chemical factors. *Acta Hydrobiol.*, 8, 127—153.
- Grygierek E., 1962. Wpływ zagęszczenia narybku karpia na faunę skorupiaków planktonowych. *RNR*, 81, B, 2, 189—210.
- Grygierek E., 1965. Zmiany rozmieszczenia skorupiaków jako wyraz oddziaływania narybku karpia na plankton. *RNR*, 86, B, 2, 183—194.
- Grygierek E., 1966. Produkcja planktonu w stawach. *Zeszyty Probl. Kosmosu*, 13, 47—56.
- Grygierek E., P. Wolny. 1965. Wpływ osuszania zimowego na występowanie ślimaków w stawach. *RNR*, 86, B, 2, 169—181.
- Gurzęda A., 1954. Doświadczenie nad wpływem obsad dwusezonowych na wydajność stawów. *Gosp. Ryb.*, 6, 9, 5—9.
- Gurzęda A., 1960. Wpływ presji narybku karpia na dynamikę liczebności *Tendipedidae* i *Cladocera*. *Ekol. Pol.*, B, 6, 257—268.
- Hilbricht-Ilkowska A., 1966. The effect of different periods of utilization of fish ponds on the occurrence and abundance of plankton *Rotatoria*. *Ekol. Pol.*, A, 14, 111—124.
- Ivlev V.S., 1933. Ein Versuch zur experimentalen Erforschung der Ekologie der Wasserbiocenosen. *Arch. Hydrobiol.*, 25, 177—191.
- Klimczyk M., 1957. Zooplankton tarlisk i przesadek. *Biul., Zakł. Biol. Stawów, PAN*, 4, 127—144.
- Klimczyk M., 1964. Plankton zwierzęcy i jego biomasa w stawach nawożonych — Das Zooplankton und seine Biomasse in den gedüngten Teichen. *Acta Hydrobiol.*, 187—205.
- Krzeczowska-Wołoszyn L., 1966. Plankton nowych stawów przesadkowych gospodarstwa Gołysz — Das Plankton der neuen Streckteiche der Teichwirtschaft Gołysz. *Acta Hydrobiol.*, 8, 47—109.
- Krzeczowska-Wołoszyn L., 1967 a. Plankton starych tarlisk karpowych w Gospodarstwie Gołysz — Das Plankton in alten Karpfenteichen der Teichwirtschaft Gołysz. *Acta Hydrobiol.*, 9, 381—394.
- Krzeczowska-Wołoszyn L., 1967 b. Plankton nowych stawów tarliskowych w Gospodarstwie Gołysz — Das Plankton der neuerbauten Laichteiche auf der Teichwirtschaft Gołysz. *Acta Hydrobiol.*, 9, 395—425.

- Morduchaj-Boltovskoj F.D., 1954. Materialy po srednemu vesu bezpozvo-  
nočnych baseina Dona. Trudy problemn. temat. sovešč. Inst. AN SSSR. 2, 223—  
—241.
- Odum T.H., 1957. Trophic structure and productivity of Silver Springs, Florida  
Ecol. Monogr., 27, 87—112.
- Odum E.P., 1963. Podstawy ekologii. Warszawa PWRiL.
- Odum E.P., 1969. Ekologia. Warszawa PWN.
- Radzimovskij D.A., 1955. O fitoplanktone novopostroennyh rybovodnyh  
prudov USSR v pervyi god zapolnenija ich vodoi. Vopr. prud. ryb. choz. USSR,  
48—66.
- Schäperclaus W., 1961. Produktionbedingungen und Ertrag in sechs verschie-  
denen Karpfenteichen. Verb. Intern. Ver. Limnol., 14, 700—708.
- Skorbatov G.L., 1954. O kormovoi baze dlja ryb v malych orositelnyh vodoe-  
mach. Trudy problemn. temat. sovešč. AN SSSR, 2, 138—148.
- Starmach K., 1955. Metody badania planktonu. Warszawa PWRiL.
- Starmach K., 1963. Staw jako środowisko hodowlane. (Hodowla ryb w stawach —  
pod redakcją A. Rudnickiego). Warszawa. PWRiL.
- Starmach K., 1969. Wody śródlądowe. Zarys hydrobiologii. UJ, Kraków.
- Stegman K., 1952. Kultura stawu rybnego. Warszawa PWRiL.
- Wunder W., 1949. Fortschrittliche Karpfenteichwirtschaft. Stuttgart.
- Wójcik-Migała I., 1965. Wpływ dwuletniego zalania stawów na faunę denną.  
RNR. 86, B, 2, 215—227.

Adres autorki — Author's address

dr Łucja Krzeczowska-Wołoszyn

Zakład Biologii Wód, Polska Akademia Nauk, Kraków, ul. Sławkowska 17