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STUDIES ON THE USEFULNESS OF DIFFERENT MESH-SIZE PLANKTON NETS FOR THICKENING ZOOPLANKTON*

ABSTRACT: Thickening of zooplankton by filtering the lake water through nylon netting of mesh-size 10, 20, 30 and 60 μm caused losses amounting to 27, 32, 43 and 54%, respectively, of the real numbers of rotifers. The netting did not significantly change the numbers of crustaceans, and only a small proportion of nauplii (up to 10%) was lost when the 60 μm net was used. Filtering was found to also affect the estimated fertility of rotifers by artificially lowering its value for the ovigerous species – *Keratella cochlearis* (Gosse), or raising – for the non-ovigerous species, *Polyarthra vulgaris* Carlin.

KEY WORDS: Lakes, zooplankton, techniques and methods.

Contents

1. INTRODUCTION

Plankton nets are commonly used for both catching and thickening the plankton. In either case they are selective. The selectivity depends on the size and shape of the mesh, type of weave and many other parameters (Bottrell et al. 1976). The commonly used plankton net 60 μm in mesh-size does not retain a considerable number of rotifers, whose body length or breadth is less or equal to 60 μm (this range covers species which are frequently encountered, e.g., *Trichocerca pusilla* (Lauterborn), *T. rousseleti* (Voigt), *Anuraeopsis fissa* (Gosse),

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Polyarthra minor Voigt, *Keratella cochlearis* (Gosse) and others) and causes considerable losse to the fauna of larger rotifers, e.g., *Keratella quadrata* (Müller), of which only 40% of individuals were retained by the 65 μm net (Doohan 1973). This may lead to an alteration of the real size structure of a population (when only smaller individuals are lost), or of female fertility (when eggs are lost), and thereby to considerable errors in the estimation of the numbers, biomass and production of the population.

The use of plankton nets of the smallest possible mesh-size (10–20 μm) would probably make it possible to considerably reduce the losses due to filtration. Unfortunately, it is not always possible to use such nets. According to Tranter and Heron (1965), the filtrative efficiency of nets becomes strongly reduced as a result of mesh plugging, especially when the mesh-size is less than 100 μm. However, this depends on the amount of water filtered, rate of filtration, and on the amount of seston.

It is possible to avoid the above difficulties by collecting unfiltered samples and sedimenting them, but the method involved is not easy when in the field, primarily because of the necessity to carry large volumes of water samples. Moreover, a proportion of the animals may become removed from a sample during the syphoning-off of the water above the sediment. In this situation the only possible method of sample collecting is the filtration of water in the field. However, it is necessary to work out a method for thickening the samples that will cause the least possible loss of the plankton material.

The present paper is of a methodological nature and its aim is to evaluate the usefulness of various mesh-size plankton nets for the thickening of zooplankton: of rotifers and crustaceans of a body-size range from 80 μm (*K. cochlearis*) up to about 800 μm (copepodites of Cyclopidae), varying in their morphology and proneness to mechanical changes in body shape and size.

The objective of the study was to select from the four net types one, the use of which would ensure the greatest reduction of the error caused by losses of the zooplanktonic material, and to suggest optimum conditions for sample filtration (e.g., minimum volumes of samples filtered).

2. MATERIAL AND METHODS

In the July of 1975 8 series of experiments were carried out: 4 series on each of two eutrophic lakes, the Mikołajskie Lake (surface area = 498 ha, maximum depth = 25.9 m, average depth = 11.1 m) and Lake Inulec (surface area = 178.3 ha, maximum depth = 10.1 m, average depth = 4.6 m). The zooplankton of the two lakes differed by numbers and specific composition. In Mikołajskie Lake the total number of rotifers was 2–3 times as larges as that found for Lake Inulec, and it varied between 702 and 997 ind./l in the individual series; in Lake Inulec it amounted to 179–281 ind./l (Table II). The total number of crustaceans in Mikołajskie Lake was 212–294 ind./l, and not much smaller (190–255 ind./l) (Table III) in Lake Inulec. Dominating in the rotifer fauna of Mikołajskie Lake were: *Keratella cochlearis*, *Synchaeta kitina* Rousselet and *Kellicottia longispina* (Kellicott); in Lake Inulec: *Keratella cochlearis* and *Polyarthra vulgaris* Carlin, most of which are species of a very small body-size. In the crustacean fauna of each of the lakes Cyclopidae dominated, in Mikołajskie Lake the dominating form being nauplii, and in Lake Inulec – copepodites.

Water with plankton in it was taken from the lake, at a depth of about 1 m, poured into a can and immediately carried to the laboratory, where, after a thorough mixing in a 10-litre tank, 3 1-litre samples were collected to be fixed with formalin and placed in 1-litre beakers and left for three days to sediment, and 3 1-litre samples each of which was separately filtered through a standard, conical plankton net with a little container and a pipe to remove the plankton. The thickened zooplankton was fixed with formalin (C), whereas the filtrate, that is to say, the water which passed through the net, was left to sediment in jars (F). On the first exposure day the surface water of the sedimentation samples was stirred several times, to free the animals trapped by the surface membrane, and subsequently the water above the sediment was syphoned off. Examined under the microscope, the water taken from 10 randomly selected samples appeared not to contain any animals.

Each series thus included 9 samples: 3 sedimentation samples (regarded as the control – S) + 3 samples that had been thickened by filtration (C) +3 samples containing sedimentation filtrate (F).

The whole contents of the samples (S, C and F) were examined under the microscope, and the rotifers and their eggs, and the crustaceans were counted for each species and stage separately.

It has been assumed that the total number of organisms lost due to the filtration of the samples through the plankton net is equal to the difference between the numbers of the animals in the sedimentation and filtration samples (S – C). However, it includes two types of loss:

1. due to the passing of the animals through the net, that is to say, the number of individuals in the filtrate (F);

2. due to destruction of animals, or their stoppage in the mesh and folds of the net, expressed as S – C – F (i.e., the difference between the total loss, S – C, and the loss described in 1 as F).

Table I. Diagonal mesh-length of four nylon nets with a manufactured mesh-size of 10, 20, 30 and 60 μm*

Length	Diagonals	Manufactured mesh-size (μm)			
		10	20	30	60
Average and standard deviation**	diagonal I	15.0 ±0.9	25.2 ±1.6	31.8 ± 1.4	58.9 ± 3.4
	diagonal II	15.2 ±0.7	25.8 ±1.3	30.9 ± 1.4	57.7 ± 2.8
Minimum***	diagonal I	13.5	22.4	29.3	58.3
	diagonal II	12.9	23.6	29.0	53.6
Maximum***	diagonal I	16.4	28.3	34.6	64.6
	diagonal II	15.7	28.3	34.6	66.1

*Trapezium-shaped mesh. **For 20 measurements. ***For randomly selected meshes.

For each lake 1 series for each of the four plankton nets, differing by mesh-size, was carried out. The nets were numbered 10, 20, 30 and 60, the numbers corresponding to the mesh-sizes in μm as specified by the manufacturers (Table I). Standard plankton nets were used made of non-expanding nylon nets manufactured by HYDRO-BIOS, Federal Republic of Germany, with mesh-sizes as in Table I.

In the present study some of the results have also been used from the experiments performed in 1974 using No. 25 net (mesh-size about 60 μm). The experiments consisted of 10 series with different densities of rotifers (from about 100 to about 8,000 ind./l) in a filtration sample. The water to be used for the experiments was taken from Mikołajskie Lake, the dystrophic Lake Flosek, and from a small astatic body of water in the precincts of the Mikołajki Field Station of the Institute of Ecology, Polish Academy of Sciences. The methods used were the same as those described above.

3. RESULTS

The calculated absolute values of the numbers of rotifers in the samples S, C and F (Table II) indicate that the overall losses (S – C) caused by filtration were fairly high and tended to increase with the increasing mesh-size of the net. This applies to both the total numbers of rotifers and the numbers of the dominant species (Table II).

Table II. Numbers of rotifers in sedimentation (S), and filtration (C) samples, and in sedimented filtrate (F) for four types of plankton net (standard deviation at $n = 3$)

Lake	Taxonomic unit		Manufactured mesh-size (μm)			
			10	20	30	60
Mikołajskie	total of Rotatoria	S	997 ± 23	725 ± 22	784 ± 30	702 ± 27
		C	835 ± 25	585 ± 25	564 ± 28	426 ± 27
		F	23 ± 4	32 ± 6	37 ± 8	185 ± 2
	Keratella cochlearis	S	383 ± 9	329 ± 20	249 ± 15	336 ± 26
		C	356 ± 14	266 ± 8	229 ± 7	214 ± 11
		F	14 ± 1	10 ± 3	10 ± 3	69 ± 3
	Synchaeta kitina	S	403 ± 16	240 ± 44	390 ± 24	211 ± 34
		C	295 ± 14	208 ± 11	231 ± 14	103 ± 6
		F	5 ± 1	18 ± 5	22 ± 2	103 ± 1
	Kellicottia longispina	S	107 ± 8	76 ± 3	73 ± 6	75 ± 2
		C	78 ± 4	54 ± 3	44 ± 10	36 ± 24
		F	1 ± 1	1 ± 1	1 ± 1	2 ± 1
Inulec	total of Rotatoria	S	179 ± 29	281 ± 17	249 ± 46	266 ± 12
		C	168 ± 24	244 ± 24	149 ± 17	151 ± 7
		F	3 ± 1	10 ± 1	12 ± 2	26 ± 1
	Keratella cochlearis	S	108 ± 17	145 ± 11	146 ± 12	153 ± 8
		C	99 ± 7	143 ± 5	91 ± 11	101 ± 3
		F	1 ± 1	6 ± 1	5 ± 1	14 ± 2
	Polyarthra vulgaris	S	66 ± 10	124 ± 13	94 ± 34	107 ± 10
		C	55 ± 19	84 ± 18	54 ± 9	39 ± 7
		F	1 ± 1	3 ± 1	7 ± 2	11 ± 2

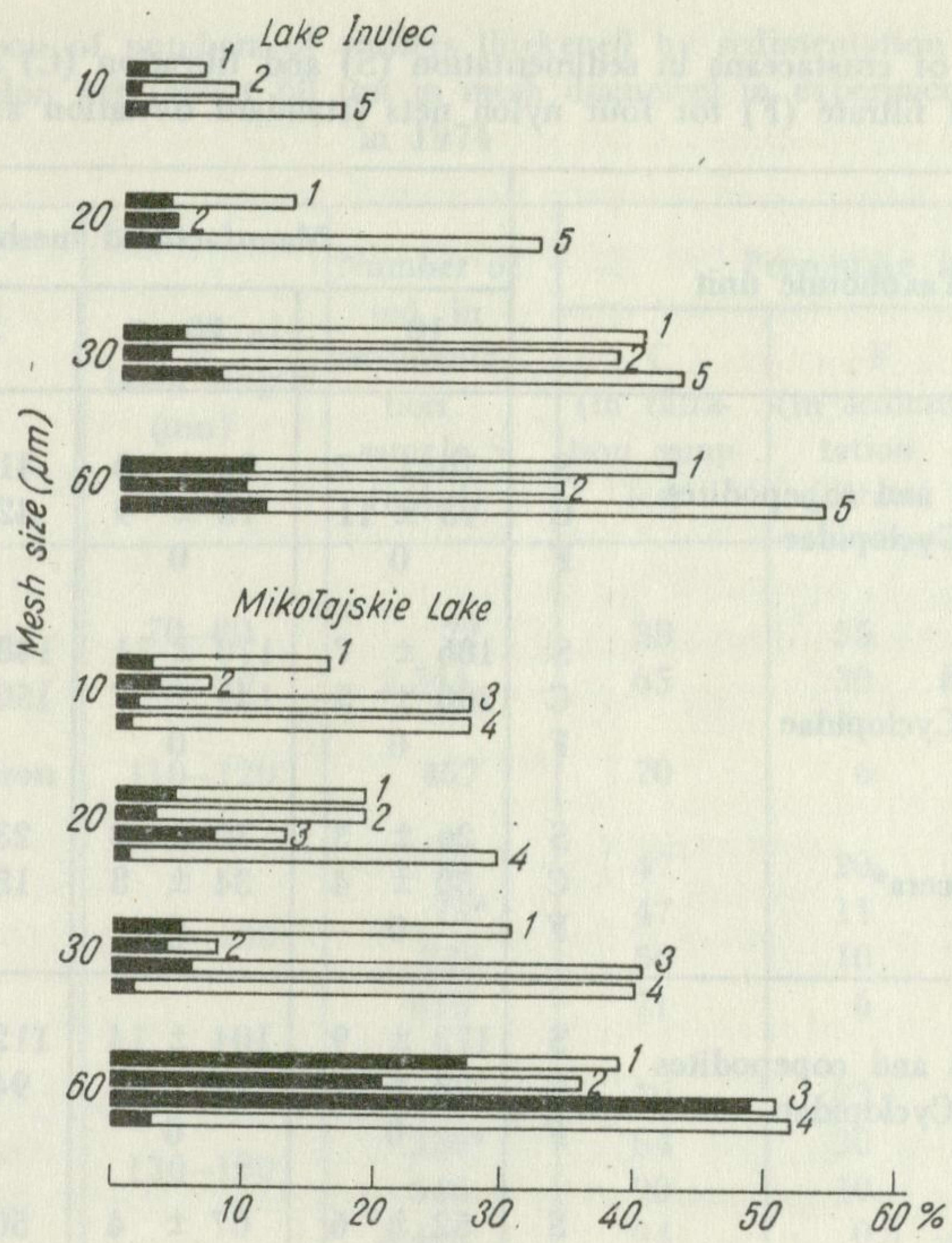

Fig. 1. Rotifer number losses due to filtration through plankton nets of different mesh-sizes, as expressed in per cent of number in sedimented samples (S)

Shaded area of diagrams – per cent of individuals passed through a net, open area – per cent destroyed; 1 – total of rotifers, 2 – *Keratella cochlearis*, 3 – *Synchaeta kitina*, 4 – *Kellicottia longispina*, 5 – *Polyarthra vulgaris*

A slightly different situation is seen if the numbers of rotifers in the sedimentation filtrate (F) are analysed, that is to say, losses connected solely with the passing of the animals through the net mesh. In the case of nets of mesh-sizes from 10 to 30 μm the losses were relatively small, their growth with the increasing mesh-size being only slightly marked, and only for the 60 μm net was a rapid growth of the number of rotifers in the filtrate observed. This is particularly evident in Figure 1, where the losses have been given in per cent of S, especially in the part describing the series with Mikołajskie Lake zooplankton.

So, although the total numbers of rotifers in the filtrates from nets 10, 20 and 30 μm did not exceed 5% S, that from the 60 μm net increased to over 25%. Similarly high losses were recorded for two small-bodied rotifer species from this lake – *Keratella cochlearis* and *Synchaeta kitina*. Only for *Kellicottia longispina* in all variants were very small losses due to the passing through the net (to about 3%) recorded, while the number of individuals destroyed and retained on the net increased.

Likewise, in the series with the zooplankton from Lake Inulec more rotifers were destroyed than could pass through the net, this applying to individuals of both *Polyarthra vulgaris* and *Keratella cochlearis*,, which in the Mikołajskie Lake series behaved in a different manner. The differences found between the series from the two lakes were surely connected with differences in the density of the seston.

Table III. Numbers of crustaceans in sedimentation (S) and filtration (C) samples, and in sedimented filtrate (F) for four nylon nets (standard deviation at $n = 3$)

Lake	Taxonomic unit		Manufactured mesh-size (μm) 10	20	30	60
Mikołajskie	adults and copepodites of Cyclopidae	S	76 ± 7	94 ± 10	41 ± 3	88 ± 3
		C	75 ± 11	73 ± 9	42 ± 5	78 ± 4
		F	0	0	0	0
	nauplii of Cyclopidae	S	186 ± 7	170 ± 11	148 ± 4	172 ± 8
		C	200 ± 5	149 ± 7	150 ± 19	154 ± 17
		F	0	0	0	6 ± 2
	Cladocera*	S	26 ± 3	30 ± 3	23 ± 2	26 ± 5
		C	30 ± 4	34 ± 8	15 ± 2	29 ± 4
		F	0	0	0	0
Inulec	adults and copepodites of Cyclopidae	S	173 ± 9	104 ± 14	112 ± 8	115 ± 4
		C	193 ± 2	112 ± 16	94 ± 2	99 ± 12
		F	0	0	0	0
	nauplii of Cyclopidae	S	52 ± 6	67 ± 4	50 ± 5	55 ± 2
		C	49 ± 5	62 ± 9	38 ± 3	51 ± 5
		F	0	0	1 ± 1	1 ± 1
	Cladocera*	S	30 ± 1	39 ± 4	28 ± 3	35 ± 2
		C	23 ± 10	33 ± 1	23 ± 2	28 ± 3
		F	0	0	0	0

*Species: *Daphnia cucullata* Sars, *Chydorus sphaericus* (O. F. Müller), *Bosmina longirostris* (O. F. Müller), *B. coregoni* Baird.

With the number of replications for each sample being small, it was feared that the above results would be affected considerably by the uneven-sampling error. Therefore for each sample the standard deviation was calculated (Tables II, III). In Table II the total of standard deviations for S and C is in most cases several times smaller than the difference between the mean value from the sedimentation and filtration samples (S – C).

It ought to be expected that the above losses of the rotifer material may be due to both the body size of the individuals and their morphological structure and numbers in a sample (or the abundance of the whole seston).

In Table IV the species are listed in the sequence from the smallest body size (*Anuraeopsis fissa* – about 80 μm in length) to the largest (*Kellicottia longispina* – about 600 μm in length). The same sequence can be seen in the decrease of losses due to filtration through the 60 μm net. However, there were exceptions to this regularity, with similar numbers of individuals in a sample, e.g., *Keratella quadrata* and *Kellicottia longispina* were retained during filtration in similar degree as *Anuraeopsis fissa*, although they are much bigger than the individuals of the latter species.

Table IV. Comparison of numbers of rotifers thickened by sedimentation and filtration through No. 25 nylon net (about 60 μm in mesh diameter) in experiments carried out in 1974

Species	Range of body length (μm)	Number of ind. in sedimentation sample S (ind./l)	Percentage in S		
			C (in filtration samples)	F (in sedimentation filtrate)	S − (C + F) (destroyed)
Anuraeopsis fissa	70–80	72	38	55	7
Polyarthra minor	80–90	2,344	65	30	5
P. dolichoptera Idelson	110–120	457	70	6	24
P. vulgaris	120–130	15	47	20	33
		73*	47	11	42
		239	56	10	34
		853	71	6	23
Keratella cochlearis	130–180	90	70	23	7
		336*	64	20	16
		546	90	10	0
		4,494	94	0.5	5.5
K. quadrata	150–300	12	39	2	59
		240	97	1	2
Kellicottia longispina	500–600	10	97	3	0
		26	46	0	54
		75*	48	3	49
		163	84	1	15

*Data from experiments carried out in 1975.

An increase in the number of rotifers considerably reduces the percentage of losses caused by filtration, both of those designated with F, and of those specified as S − (C + F) (Table IV). In *Polyarthra vulgaris* the overall losses grew with the decrease in numbers from 853 to 15 ind./sample from 29 to 53%. In the case of *Keratella cochlearis* a 50-fold decrease in numbers was followed by a 5-fold increase in losses. A similar situation was observed for *Keratella quadrata* and *Kellicottia longispina* (the results at 10 ind./sample of the latter species may be accidental). A high density accounts also for the small loss of *Polyarthra minor*, a very small-bodied species, the individuals of which ought to pass through the net in considerable numbers, for a loss of 35% of individuals with a density of 2,000 ind./l is rather a high loss.

A decrease in the overall losses (S − C) is particularly evident in cases where there occur changes in the total density of rotifers, from several to 3,000 ind./sample, later on, the course of this fall becomes less rapid, and from a density level of 6,000 ind./sample it almost remains unchanged at the level of 2% (Fig. 2).

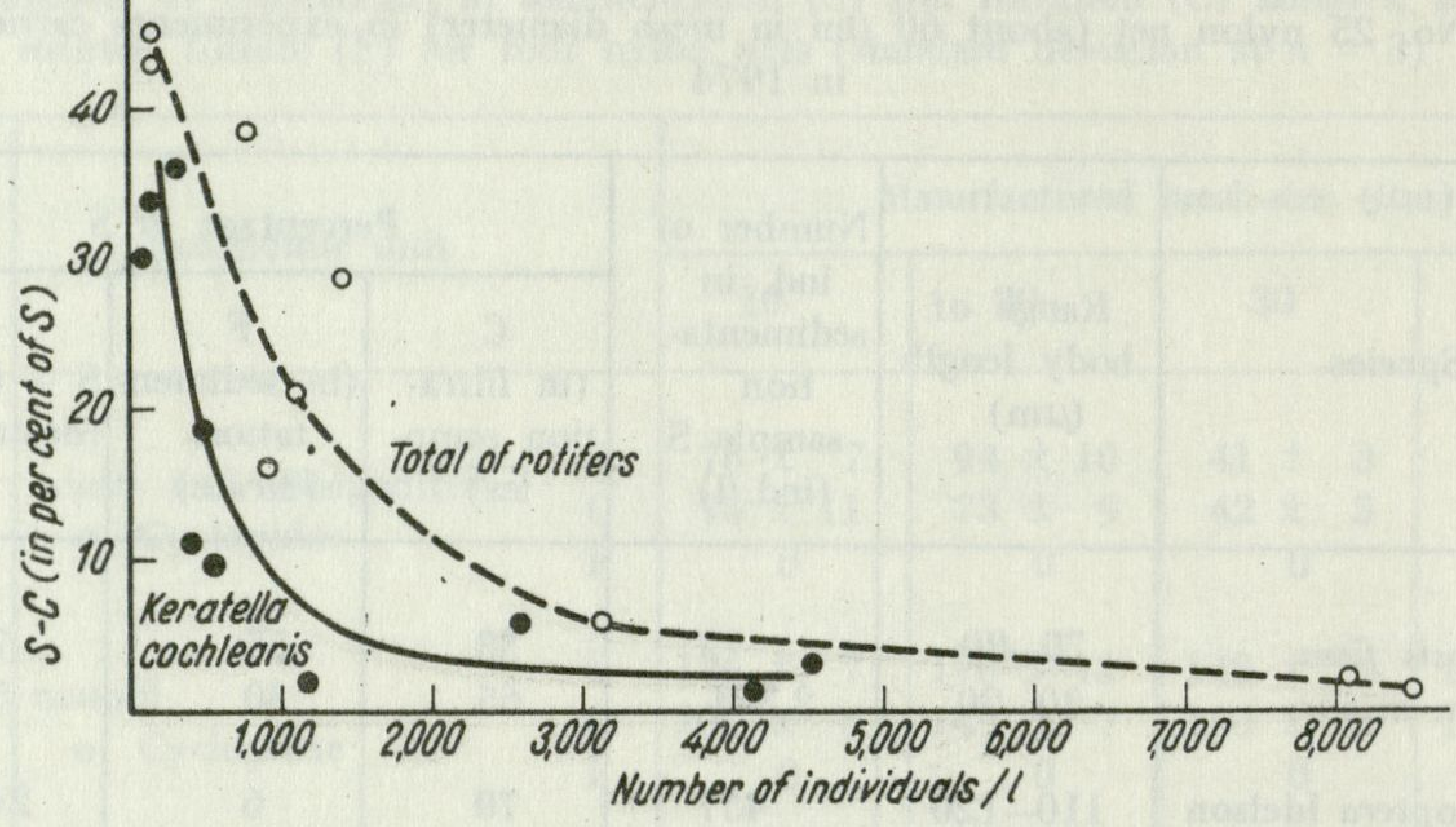

Fig. 2. Numeric losses (S − C, as expressed in per cent of S) due to filtering through No. 25 (about 60 μm in mesh diameter) plankton net, depending on the density of small-bodied rotifers (up to 150 μm in length) in a filtration sample (on the basis of all the experiments carried out in the years 1974–1975)

Table V. Comparison of the fertility (average number of eggs per female) of females of *Keratella cochlearis* and of *Polyarthra vulgaris* in Mikołajskie Lake and in Lake Inulec, in sedimentation (S) and filtration (C) samples (standard deviation at $n = 3$)

Manufactured mesh-size (μm)		*K. cochlearis*		*P. vulgaris*	
		Mikołajskie	Inulec	Mikołajskie	Inulec
10	S	0.19 ± 0.01	0.15 ± 0.02	0.62 ± 0.10	0.18 ± 0.02
	C	0.19 ± 0.03	0.25 ± 0.08	1.06 ± 0.21	0.29 ± 0.05
20	S	0.17 ± 0.03	0.30 ± 0.08	0.70 ± 0.15	0.19 ± 0.04
	C	0.15 ± 0.06	0.31 ± 0.02	1.15 ± 0.05	0.37 ± 0.03
30	S	0.19 ± 0.03	0.27 ± 0.02	0.72 ± 0.05	0.20 ± 0.04
	C	0.17 ± 0.02	0.27 ± 0.03	1.25 ± 0.20	0.34 ± 0.10
60	S	0.20 ± 0.02	0.30 ± 0.01	0.60 ± 0.08	0.25 ± 0.05
	C	0.18 ± 0.03	0.29 ± 0.02	1.17 ± 0.15	0.41 ± 0.08

In the estimation of the production of the rotifers an important factor is the number of eggs. Since they are smaller than the adult females, it was feared that much more eggs would be lost due to filtration than females. In the experiments here described all eggs were counted, even those that had come off the females. It has been found that the fertility (average number of eggs per female) of *Polyarthra vulgaris* was significantly higher in the filtration samples from both lakes, whereas that of *Keratella cochlearis* was slightly higher in the sedimentation samples, but the difference in fertility between the two sample types was in the latter case within the range of error (Table V). No directional changes were found in the number of eggs following changes of net mesh-size, hence the ratio of eggs lost to females lost was similar for all the nets used. This does not agree with the results reported by Lickens and Gilbert (1970), who found a clear increase in fertility as the net mesh-size increased.

In the present studies the usefulness has also been tested of plankton nets with mesh-sizes from 10 to 60 μm in diagonal for the thickening of crustacean samples. No major losses have been recorded for any of the nets used, even in the case of the smallest forms, that is to say the nauplii of Cyclopidae (Table III). Only in the case of the Mikołajskie Lake zooplankton in the filtrate from the 60 μm net was a small number of nauplii found (3.5% S), the overall losses (S – C) not exceeding 10%.

4. DISCUSSION

When collecting zooplankton samples in the field, it is often very difficult, for various reasons, to thicken the samples by sedimentation, especially when less fertile lakes are involved. So, plankton nets become necessary to obtain a thickened plankton material. However, most investigators are aware of the fact that the use of nets may cause situations where the densities of organisms in samples will differ from the real ones. Hence attempts have been made to investigate the problem.

The experiments described in this paper, as well as the studies carried out by Hillbricht-Ilkowska (Botrell et al. 1976), Lickens and Gilbert (1970) and Doohan (1973) indicate that losses caused by filtering the lake water through plankton nets may be very high, especially with regard to small rotifers. Lickens and Gilbert (1970) recorded losses to plankton material, similar to those reported in the present paper, depending on the mesh-size of the net used for the filtration. They used nets of a mesh-size different from that described in this paper, but in their investigations the overall losses to the density of rotifers were also small when nets of 35 and 48 μm in mesh diameter were used, and tended to increase when a net of 75 μm in mesh diameter was used. Particularly evident were the losses recorded for *Polyarthra vulgaris*, where the average number of individuals in a sample thickened by means of the 75 μm net represented only 38% of the number of individuals retained on the 35 μm net.

The different rotifer species differ by their proneness to destruction and retention by the net, and different also may be the mechanism of the losses. Individuals of soft-bodied species are particularly prone to mechanical destruction(destroyed bodies of individuals may be seen during the examination of a material containing *Polyarthra*). Lickens and Gilbert (1970) recorded higher losses in the case of soft-bodied rotifers such as *Polyarthra vulgaris*, but they have not tried to explain this phenomenon. It seems, however, that in addition to mechanical destruction ("smashing"), an important factor is also the retention on the net, to a large extent due to the presence of long and slender paddles.

Such a mechanism of the removal of animals from filtered samples is probably more characteristic of rotifer forms with lorica, possessing numerous thin, sharp spines, often curved at the end (e.g., in *Kellicottia longispina*, *Keratella* sp., *Brachionus* sp.), which may function as hooks. When hooked to the net, the animals cannot be easily washed off.

Hard-bodied rotifers (Lickens and Gilbert 1970), devoid of spines, may to a lesser extent be subject to losses, provided they are big enough not to pass through the net, and the shape of their body does not cause their getting stuck in the net. A slender, tapering body (e.g., in *Kellicottia*, *Notholca*) may facilitate the piercing of individuals into the net mesh if they do not go into it the posterior spine first, which should happen fairly often, because the strong flow of water in one direction should favour such a position of the body. Lorica-less rotifer species with a fairly strong cuticle and elastic body may be subject to quite considerable losses but more due to the increased possibility of "squeezing" through the net mesh, that is to say, passing into the filtrate (e.g., *Synchaeta kitina* – Table II) than to a mechanical destruction.

Because of their more streamline shapes and strong coverings, the eggs of rotifers are acted upon by another complex of mechanisms causing losses during the filtration, and it seems that the mechanisms causing losses to eggs carried by the females are different from those bringing about losses to the eggs freely floating in the water. It is possible to compare the effects of filtration for both egg types, because in the present experiments the fertility was studied of both an ovigerous species (*Keratella cochlearis*) and a species losing eggs before and during the filtration (*Polyarthra vulgaris*). The ovigerous females of the former are less easily lost than are those without eggs, but at the same time the eggs that fall off the females, due to the handling, may more easily, because of being smaller, pass through the net.

It is, therefore, difficult to foresee which of the mechanisms will predominate, and whether the value of fertility will increase or decrease. There is a high probability that, as in the case here described, the opposite mechanisms will counterbalance each other and fertility will not be changed considerably. It is more difficult to foresee the direction of changes in the non-ovigerous species, since it depends equally on the shape and size of the eggs and of the females. In the present study the species *Polyarthra vulgaris* was used, the individuals of which were easily destroyed, and the fertility estimated from the filtered samples was almost twice as high as that from the sedimented samples (Table V). This situation can be explained if it is assumed that the percentage of females lost was higher than the percentage of the eggs which passed through the net.

As regards the hard-bodied and non-ovigerous rotifers, the situation concerning changes in fertility may be quite different. Lickens and Gilbert (1970) have found for both *Polyarthra vulgaris* and *Keratella cochlearis* a very clear increase in the per cent contribution of females with eggs in the samples filtered through a net with a larger mesh-size, which perfectly agrees with the description of the phenomena relating to the non-ovigerous species, an example of which is *Polyarthra vulgaris*, used in the studies described in the present paper. Likewise, the increased fertility of *Keratella cochlearis* in the investigations carried out by Lickens and Gilbert (1970) would not significantly disagree with the above conclusions if the females of this species did not lose their eggs, as a result of the manipulations. It is difficult to say if this was the case.

5. PRACTICAL RECOMMENDATIONS

Each rotifer species may be subject to different mechanisms causing losses during sample filtration through a plankton net. If this is combined with the dependence of the losses not only on the size and shape of the body of an animal, but also on the density of the seston in the sample, it is extremely difficult to forecast the value of losses in each particular case. Similar difficulties are encountered when forecasting changes in the fertility of rotifers. Efforts should, therefore, be made not towards finding proper corrections that could be applied to reduce the losses, but towards finding a methodology of sample collecting and thickening, the use of which would make it possible to at least limit the losses, if not to eliminate them. This is in essence in agreement with the final conclusions put forward by Lickens and Gilbert (1970).

On the basis of the results given in the present paper an attempt may be made at giving several recommendations concerning the use of plankton nets for thickening zooplankton:

1. Plankton nets of mesh-sizes up to 60 μm (along the diagonal) are fully useful for thickening crustacean zooplankton.

2. For the thickening of rotifer material the use is recommended of nets with a small mesh-size, 10 or 20 μm, the latter seeming to be better, because with the same magnitude of losses in the rotifer material its filtrative capacity is much higher. The use of nets so dense in eutrophic lakes may be connected with difficulties, especially during phytoplankton blooms. In such situations it is possible to use nets of 60 μm in mesh-size, but only when at least 5 litres of water is being strained. If this net is used to thicken the plankton from oligo- and mesotrophic lakes, each lake water sample strained should be at least 50 litres in volume.

3. Complying with the above recommendations, one should also be able to considerably reduce the artificial changes in the estimated fertility of rotifers, of both the ovigerous species and those whose eggs float freely in the water.

4. Losses to the density of rotifers in a filtered sample can additionally be reduced by carefully pouring the water with the plankton in it into a net which is partially dipped in water, and then washing the net walls by partially dipping the net several times and gentle shaking. The latter procedure will make it possible to recover at least some of the individuals that got stuck in the net mesh.

6. SUMMARY

The usefulness was studied of plankton nets varying in mesh-size (10, 20, 30 and 60 μm in the widest part – Table I) for the thickening of zooplankton of Mikołajskie Lake and Lake Inulec.

As a result of filtration of water samples through plankton nets, considerable amounts of rotifer material were lost (a maximum of about 50%) (Table II, Fig. 1), and only small amounts of crustacean material, mainly nauplii of Cyclopidae (a maximum of about 10% – Table III). The types and the magnitude of losses to the rotifer fauna depended on: mesh-size (Fig. 1), morphology and body size of the individuals (Table IV), and the density of seston and of the rotifers in the water that was being filtered (Fig. 2).

The estimated values of rotifer fertility were found to have changed as a result of filtration: a slight artificial lowering, or no changes at all, for the ovigerous species (*Keratella cochlearis*) and an almost two-fold increase for the non-ovigerous species (*Polyarthra vulgaris*) (Table V).

On the basis of the results the use is recommended of nets with smaller mesh-sizes (mainly 20 μm) for the thickening of rotifer plankton from less fertile lakes, and of nets with a larger mesh-size (60 μm) for eutrophic lakes, especially in the period of phytoplankton blooms.

7. POLISH SUMMARY

Zbadano przydatność siatek planktonowych o różnej wielkości oczek (10, 20, 30 i 60 μm długości w najszerszym miejscu – tab. I), do zagęszczania zooplanktonu z Jeziora Mikołajskiego i jeziora Inulec.

Filtrowanie próbek wody przez siatki planktonowe powodowało duże straty w materiale wrotków (maksymalne – ok. 50% – tab. II, rys. 1) i niewielkie ubytki w materiale skorupiaków, głównie naupliusach *Cyclopidae* (maksymalne ok. 10% – tab. III).

Charakter i wysokość strat w faunie wrotków uzależnione były od: wielkości oczek siatki (rys. 1), budowy morfologicznej i wielkości ciała osobników (tab. IV) oraz gęstości sestonu i liczebności wrotków w wodzie filtrowanej (rys. 2).

Zanotowano też zmiany w wartościach oceny płodności wrotków w wyniku filtrowania: nieznaczne sztuczne obniżenie lub brak zmian u jajonośnego gatunku (*Keratella cochlearis*) i prawie dwukrotne podwyższenie u gatunku nie noszącego jaj (*Polyarthra vulgaris*) (tab. V).

Na podstawie wyników pracy zalecono preferowanie siatek o mniejszych oczkach (głównie 20 μm) do zagęszczania planktonu wrotkowego z jezior mniej żyznych i siatek o większych oczkach (60 μm) dla jezior eutroficznych, zwłaszcza w okresie zakwitów fitoplanktonu.

8. REFERENCES

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