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THE SPECIES DIVERSITY, NUMBERS AND BIOMASS OF BENTHIC NEMATODES IN CENTRAL PART OF LAKES WITH DIFFERENT TROPHY*

ABSTRACT: The maximum numbers, biomass and number of species was found in profundal of oligotrophic lakes, minimal – in strongly eutrophic and dystrophic lakes during the studies of 17 lakes. A correlation was found between the species diversity of nematodes and trophy of lakes studied.

Contents

1. INTRODUCTION

There are very few data on the species diversity and numbers of benthic nematodes in lakes with different trophy. The studies by S t a ń c z y k o w s k a (1967) dealing with profundal microbenthos of lakes in Northern Poland show that numbers of *Nematoda* in eutrophic and mesotrophic lakes varied from 3 to 11 thousand of individuals per 1 m^2. The above author found a complete lack of nematodes in dystrophic lakes. B i r o (1973) noted numbers of *Nematoda* of similar order of magnitude (5–30 thousand of individuals per 1 m^2) in the mud of Lake Balaton.

The earlier papers (M i c o l e t z k y 1922, 1925, S c h n e i d e r 1922, 1925, S t e f a ń -

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s k i 1923, 1936, 1938) show that nematodes of alpine oligotrophic lakes are distributed more evenly and that there are more species of them than in eutrophic East-Holshtinian and Danish lakes.

This paper aimed at the comparison of nematode species composition, numbers and biomass in the profundal of lakes with different trophy. The profundal zone was chosen for the comparison, considering the differentiated and astatic littoral environments in the contrary to relatively stable conditions in deep parts of lakes.

2. AREA AND METHODS

The studies were carried out in 17 lakes during 1971–1974. The following three lakes were the main object of studies: Mikołajskie (Masurian Lakeland), Żarnowieckie (Kaszuby District) and Char (Canada, 74° N, Cornwallis Island), with Mikołajskie Lake studied the most intensively. The secondary objects of studies were lakes in Węgorzewo area[1] : Dgał Mały, Piecek, Czarna Kuta, Smolak and the Tatra lakes: Czarny Gąsienicowy, Zielony Gąsienicowy, Morskie Oko, Wielki and Zadni in Valley of Five Polish Lakes. Also the following lakes were studied extensively: Luterskie, Dadaj, Sasek Wielki, Narie and Lake Finsevann in Norway. The general characteristics of all lakes studied is given in Table I.

Table I. Characteristics of lakes studied

No.	Lake	Surface area (ha)	Depth (m)		Trophic type
			maximum	mean	
1	Char (Canada)	52.6	27.6	10.2	oligotrophic
2	Czarny Gąsienicowy	17.8	51.0	21.1	oligotrophic
3	Czarna Kuta	25.2	3.6	1.3	eutrophic
4	Dadaj	977.0	39.8	12.3	β-mesotrophic
5	Dgał Mały	14.3	15.8	4.3	eutrophic
6	Finsevann (Norway)	325.0	26.0		oligotrophic
7	Luterskie	691.1	20.7	7.2	eutrophic
8	Mikołajskie	460.0	27.8	11.0	eutrophic
9	Morskie Oko	34.9	50.8	28.4	oligotrophic
10	Narie	1,240.0	43.8	10.0	eutrophic
11	Piecek	23.3	8.4	3.4	eutrophic with features of dystrophy
12	Sasek Wielki	869.0	38.0	8.1	eutrophic
13	Smolak	5.3	5.1	2.4	dystrophic
14	Wielki	34.3	79.3	37.7	oligotrophic
15	Zadni	6.5	31.6	14.2	oligotrophic
16	Zielony Gąsienicowy	3.8	15.2	6.8	oligotrophic
17	Żarnowieckie	1,431.6	19.4	8.4	β-mesotrophic

The field studies were carried out in summers (mainly in July). The mud samples were collected with the help of a tubular sampler of K a j a k, K a c p r z a k and P o l k o w s k i

[1]Data from these lakes were gathered during four years (1971–1974) for the project: The influence of mineral fertilization on meiobenthos. Here only the 1971 data concerning the nematodes were considered.

(1965) with sampling area of 10 or 20 cm^2. The surface 4–5 cm layer of bottom sediments was analysed. In the majority of cases at each sampling site 5 samples with 10 cm^2 sampler, or 3 with 20 cm^2 one were taken. 3 to 20 sampling sites were analysed in lakes studied.

For the analysis of samples a method described in other paper (P r e j s 1977) was used.

The biomass (expressed as dry weight) of particular species of nematodes was determined weighing each time 25–100 individuals (of similar size) in thin aluminium foil on Cahn electro-balance (± 2 µg), after previous drying in 60°C for 12 h. The fresh weight of some species was determined according to A n d r a s s y 's (1956) method based on measurements of nematodes:

$$\frac{W^2 \times L}{16 \times 100{,}000} = (\mu g)$$

where W – the widest part of body, L – body length.

According to data of R a i n b o w (1971) and K. Prejs (unpublished data) it was assumed that the ratio of dry to fresh weight of nematodes is 1 : 5.

3. RESULTS

The numbers and dominance structure of particular groupings of nematodes for 17 lakes studied is given (Fig. 1). The oligotrophic and eutrophic lakes were arranged according to advancing trophy. For six lakes (Mikołajskie, Żarnowieckie, Czarna Kuta, Dgał Mały, Piecek and Smolak) the material was gathered during a whole year. It was found that the average numbers of nematodes of particular lake based on the yearly data was not significantly different (± 20%) from numbers obtained on the basis of samples collected at few sampling sites in July. Thus it can be said that for rough data on species composition and numbers of profundal nematodes it is enough to collect summer samples. In this situation a group of compared lakes was enlarged with further 11 lakes sampled only in July.

The highest numbers of nematodes (about 700 thousand of individuals per 1 m^2) was found in two oligotrophic lakes: Zielony Gąsienicowy and Char (Fig. 1).

So high numbers of nematodes were never found in profundal of mesotrophic and eutrophic lakes (it was found on the basis of July data and other data not considered in this paper). Among these lakes the highest number (140,000 individuals per 1 m^2) was found in Lake Dadaj with poorly advanced eutrophy. However, it should be added that data for this lake were collected at depths not greater than 14 m, and it is very likely that deeper there would be less nematodes. The highest average numbers of nematodes found in shallow parts of profundal of lakes Mikołajskie and Luterskie were equal to the lowest average numbers of nematodes at some sites of oligotrophic lakes. However, the comparison of numbers of nematodes from deepest sites of two groups of lakes showed much higher values for oligotrophic lakes (Table II). In these lakes, in the contrary to eutrophic ones, there was no decrease of nematode numbers with the increase of depth, but very often an increase of this value.

The lowest numbers of nematodes (0.5–2 thousand of individuals per 1 m^2) were found in highly eutrophic and dystrophic lakes (Dgał Mały, Piecek, Smolak), and in highly eutrophic bays of Lake Narie.

The highest biomass of nematodes (416.1 mg per 1 m^2) was found, as in the case of numbers, in oligotrophic Zielony Gąsienicowy (Fig. 2). In the Char Lake, where nematode

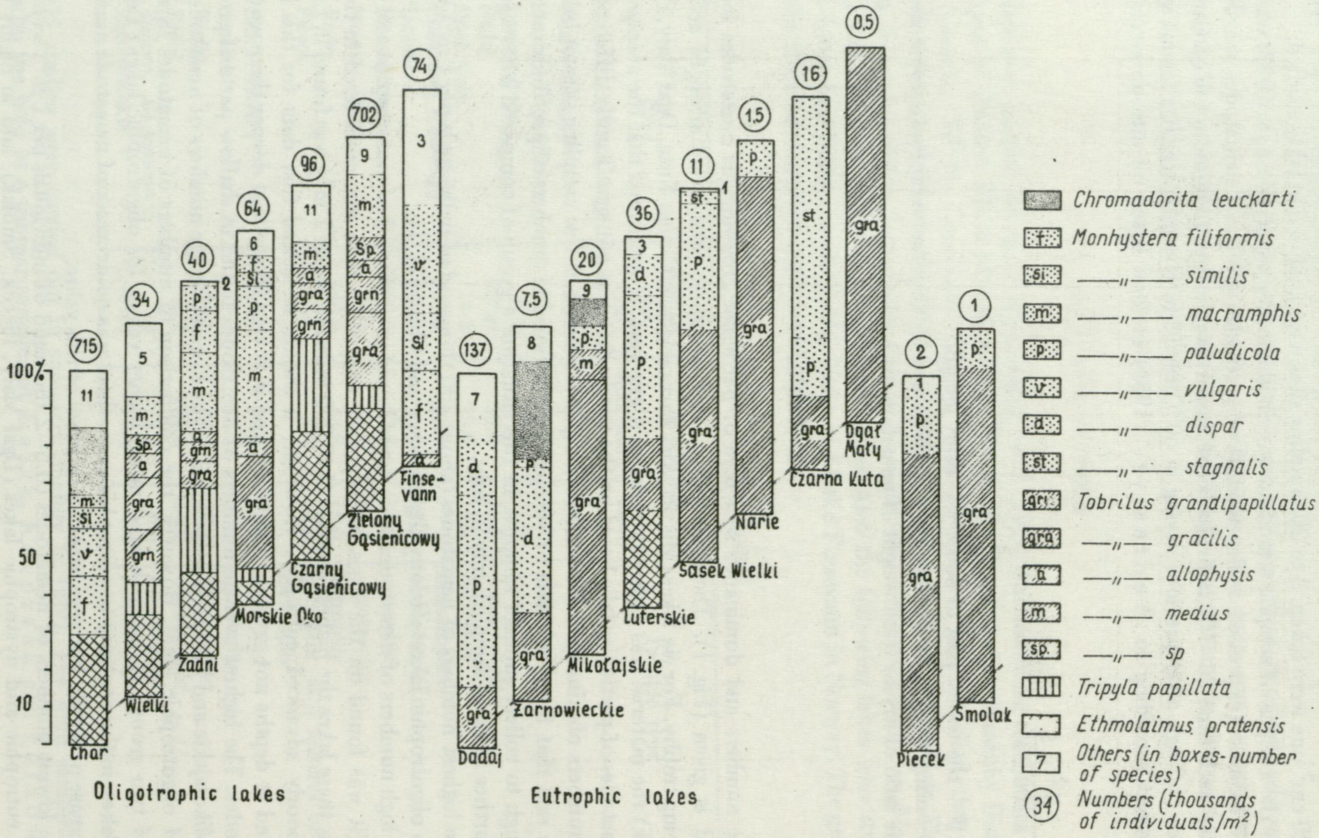

Fig. 1. Numbers and dominance structure of benthic nematodes in central parts of lakes studied

Table II. Average numbers of nematodes, number of species and Shannon index of species diversity ($\bar{H}$) for central parts of lakes studied (data for July)

Lake	Depth (m)	Numbers (thousands of individuals/m^2)	Number of species	$\bar{H}$
1	2	3	4	5
Char (Canada)	12	400	12	2.68
	14	640	16	2.79
	16	430	13	2.72
	22	1,005	12	2.62
	25	906	13	2.57
	26	670	13	2.69
Wielki	55	11	6	2.52
	68	25	7	2.32
	80	51	9	2.90
Zadni	25	40	8	2.68
	30	50	7	2.70
Morskie Oko	39	17	9	2.75
	49	160	7	1.50
	51	86	8	2.57
Czarny Gąsienicowy	8	60	9	2.20
	18	97	8	—
	30	110	9	1.80
	49	120	9	2.80
Zielony Gąsienicowy	6	216	7	1.95
	9	530	9	1.70
	12	1,000	12	—
	15	1,160	9	2.57
Finsevann (Norway)	25	74	7	2.17
Dadaj	12	135	9	2.10
	14	140	7	1.90
Żarnowieckie	10	7	6	2.59
	16	6	4	1.79
Luterskie	10	88	7	1.91
	14	12	5	1.30
	16	8	4	—
Mikołajskie	10	79	12	1.14
	16	10	7	1.66
	18	7	6	1.49
	25	12	3	0.31
Sasek	10	13	3	1.79
	14	10	3	—
Narie	10	2	2	0.40
	14	1	1	0

Table II (contd)

1	2	3	4	5
Czarna Kuta	2.5 3.0	21 10	3 3	1.20 0.90
Dgał Mały	7 12	1 0	1 0	0 0
Piecek	8 10	2 2	3 2	1.80 0.90
Smolak	4.5	1	2	0.30

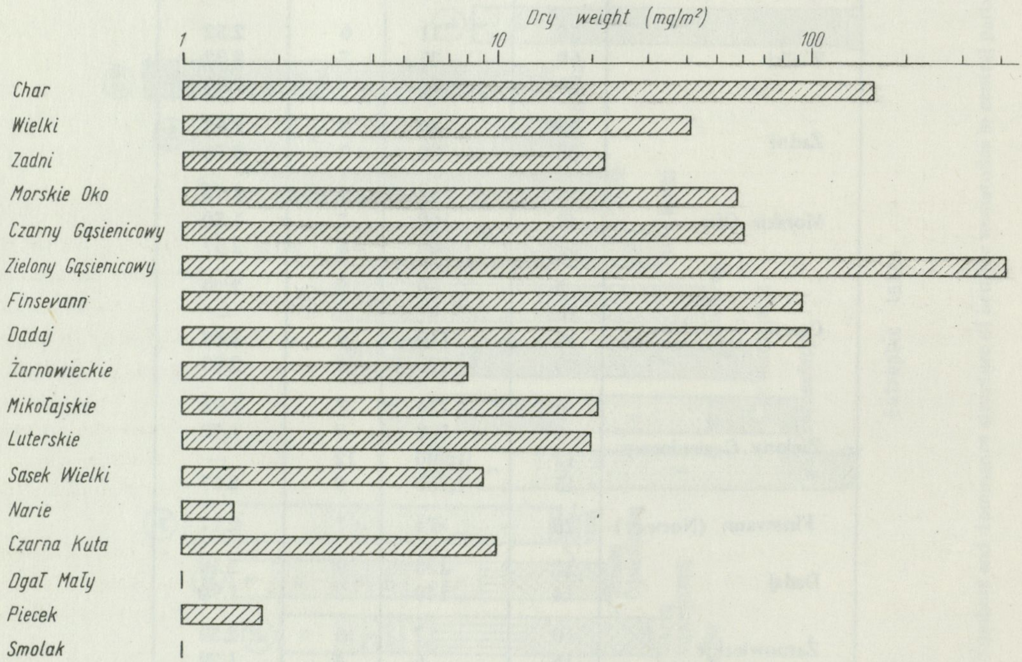

Fig. 2. Biomass of benthic nematodes in central parts of lakes studied

numbers were equal to value for Zielony Gąsienicowy, their biomass was about 2.5 times lower. This results from decisively greater contribution of species with low individual weight (*Ethmolaimus pratensis*[2], *Monhystera filiformis*, *M. vulgaris*, *Microlaimus arcticus*) in Char Lake, while larger species (*Tobrilus* spp., *Monhystera macramphis*, *Tripyla papillata*) dominated in Zielony Gąsienicowy (Table III). The lowest values of nematode biomass among all the compared lakes (0.5–1.8 mg per 1 m^2) were found in lakes Dgał Mały, Smolak and Piecek (Fig. 2).

[2]Full scientific names of species are given in Table IV.

Table III. Weights and lengths of benthic nematodes

Species	Length (mm)	Weight (µg dry weight)
Ethmolaimus pratensis	0.7–0.9	0.14–0.16
Chromadorita leuckarti	0.8–1.3	0.3–0.5
Mononchus niddensis	1.0–2.0	0.4–1.7
Eudorylaimus carteri	2.8–4.0	5.0–9.0
♀	2.2–2.5	2.0–3.5
♂	2.0–2.4	2.0–3.4
Eudorylaimus sp.	1.0–1.25	≈ 1
Tobrilus aequiseta	1.6–2.0	0.9–1.0
Tobrilus sp.	1.3–1.5	0.6–0.7
Monhystera macramphis	1.0–1.3	0.4–0.5
M. similis	0.5–0.9	≈ 0.1
M. vulgaris	0.4–0.5	≈ 0.05
M. filiformis	0.4–0.6	≈ 0.05
Plectus parvus	0.6–0.9	0.3–0.4
Microlaimus arcticus	0.3–0.4	≈ 0.05
Prismatolaimus intermedius	0.5–0.8	≈ 0.1

Seven to 17 species of nematodes occurred in profundal of oligotrophic lakes (Table IV). A decisive dominant species was not found in the grouping of benthic nematodes in these lakes – seldom a species made up more than 30% of total number (Fig. 1). The most numerous in this grouping were *Ethmolaimus pratensis*, *Tripyla papillata*, *Tobrilus gracilis*, *Monhystera macramphis*, *M. vulgaris* and *M. filiformis*. The highest number of species was found in lakes Czarny Gąsienicowy (17), Char (17) and Zielony Gąsienicowy (16), the lowest one (7) in Lake Finsevann.

The species composition of profundal nematodes in moderate eutrophic lakes was poorer than in oligotrophic lakes. The highest number of species (12) was found in shallow profundal of lakes Mikołajskie and Żarnowieckie. In the majority of cases one or two species dominated in eutrophic lakes (Fig. 1).

The lowest number of nematode species was found in highly eutrophic and in dystrophic lakes (maximum 4 species); usually one of them dominated. *Tobrilus gracilis* dominated in lakes Sasek Wielki, Narie, Dgał Mały, Smolak and Piecek, while *Monhystera stagnalis* in Czarna Kuta (Fig. 1).

Analysis of genera *Tobrilus* and *Monhystera* represented by the highest number of species showed, that they were represented by average of 4 species occurring in the same environment of oligotrophic lakes. In eutrophic lakes – two species of the same genus occurred at the most.

Expressing the species diversity of benthic nematodes in studied environments by Shannon index $(\overline{H})^3$, its highest value was found for highly oligotrophic lakes, the lowest one – for highly eutrophic and dystrophic lakes (Table II). The value of this index for oligotrophic lakes varied

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[3] Shannon species diversity index:

$$\overline{H} = -\sum \frac{n_i}{N} \ln \frac{n_i}{N}$$

where: n_i numbers of consequent species, N – total number.

Table IV. Species composition of benthic nematodes in central

Species	Char	Wielki	Zadni	Morskie Oko	Czarny Gąsieni-cowy	Zielony Gąsieni-cowy	Finsevann
Diplogaster rivalis (Leydig)							
Plectus granulosus Bastian							
P. rhisophilus de Man							
P. parvus Bastian	+						
Aphanolaimus attentus de Man							
Cylindrolaimus melancholicus de Man	+						
C. communis de Man							
Anonchus mirabilis (Hofmänner et Menzel)							
Monhystera dispar Bastian				+		+	
M. filiformis Bastian	+	+	+	+	+	+	+
M. macramphis Filipjev	+	+	+	+	+	+	
M. paludicola de Man			+	+		+	
M. similis Bütschli	+			+	+	+	+
M. stagnalis Bastian							
M. vulgaris de Man	+						+
Hofmaenneria sp.	+						
Chromadorita leuckarti (de Man)	+						
Prismatolaimus dolichurus (de Man)				+	+		
P. intermedius (Bütschli)	+						+
Ethmolaimus pratensis de Man	+	+	+	+	+	+	
Achromadora terricola (de Man)	+	+			+	+	
Microlaimus arcticus Mulvey	+						
Microlaimus sp.					+		
Tripyla papillata Bütschli		+	+	+	+	+	
T. monohystera de Man	+						
T. cornuta Skwarra							
Tobrilus aequiseta (W. Schneider)	+						
T. allophysis (Steiner)			+	+	+	+	+
T. gracilis (Bastian)		+	+	+	+	+	
T. grandipapillatus (Brakenhoff)		+	+	+	+	+	
T. medius (G. Schneider)							
Tobrilus sp.	+	+		+		+	
Ironus tenuicaudatus de Man		+		+	+	+	
Eudorylaimus carteri (Bastian)	+		+		+	+	
Eudorylaimus sp.	+						
Dorylaimus stagnalis Dujardin							
D. flavomaculatus v. Linstov							
Dorylaimus sp.		+					+
Mononchus niddensis Skwarra	+						
M. truncatus Bastian		+	+	+	+	+	+
Alaimus primitivus de Man					+		
Tylenchidae g. sp.					+		
Total numer of species	17	12	10	14	17	16	7

parts of lakes studied (data from whole material)

Dadaj	Żarno-wieckie	Mikołaj-skie	Luterskie	Sasek Wielki	Narie	Czarna Kuta	Dgał Mały	Piecek	Smolak
		+							
+	+								
+	+	+						+	
		+							
+	+	+	+						
+	+	+	+	+	+	+		+	+
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+	+	+							
10	12	12	7	4	2	3	1	3	2

at particular sites from 2.9 to 1.5 (in one case) and was on the average over 2. For mesotrophic lakes this value varied from 2.6 to 1.8. Within a group of eutrophic lakes species diversity index varied from 1.9 (Luterskie) to 0 (Dgał Mały).

A correlation was found (with $r = -0.84$) between the species diversity index for nematodes and the trophy of studied lakes (Fig. 3); with the advancing trophy the species diversity decreases (from oligo- to eutrophy).

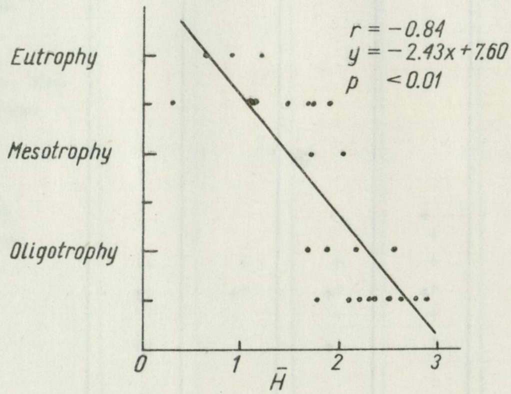

Fig. 3. The relation between lake trophy and Shannon index of species diversity ($\bar{H}$)

Species composition of nematode groupings of studied lakes was compared using the Sörensen species similarity index (Q/S)[4]. This comparison shows that three groups of lakes similar as far as species composition of benthic nematodes is concerned can be distinguished within the group studied (Fig. 4).

Group I – oligotrophic Tatra lakes (Q/S = 64–87%). Eight species of nematodes occurred in all lakes within this group.

Group II – lowland, highly eutrophic and dystrophic lakes Sasek Wielki, Dgał Mały, Narie (only highly eutrophic part of large lake was studied), Czarna Kuta, Piecek and Smolak (Q/S = 50–100%). Similarity among these lakes is based on the occurrence of a low total number of species (2–4), two of which, *Tobrilus gracilis* and *Monhystera paludicola*, occur in nearly every lake.

Group III – mesotrophic and eutrophic lakes Dadaj, Żarnowieckie, Mikołajskie and Luterskie (Q/S = 50–73%). For species of nematodes occurred in all lakes, 3 were common for the majority of lakes within this group.

Fairly obvious is small similarity of arctic oligotrophic Char Lake (Canada) to Polish mountain oligotrophic lakes. Only 5 species (*Ethmolaimus pratensis*, *Monhystera filiformis*,

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[4] Sörensen species similarity index:

$$Q/S = \frac{2j}{a+b} \times 100$$

where: a – number of species in environment A, b – number of species in environment B, j – number of species in common.

Lakes	Char	Wielki	Zadni	Morskie Oko	Czarny Gąsienicowy	Zielony Gąsienicowy	Dadaj	Żarnowieckie	Mikołajskie	Luterskie	Sasek Wielki	Narie	Czarna Kuta	Dgał Mały	Piecek	Smolak
Char																
Wielki	21															
Zadni	30	73														
Morskie Oko	26	77	75													
Czarny Gąsienicowy	29	69	67	64												
Zielony Gąsienicowy	30	78	77	87	73											
Dadaj	15	18	30	33	22	38										
Żarnowieckie	14	25	27	38	21	36	73									
Mikołajskie	21	17	27	31	14	28	54	50								
Luterskie	17	21	35	48	25	43.	59	63	53							
Sasek Wielki	0	13	31	23	10	21	31	27	27	40						
Narie	0	14	33	25	10	22	33	28	28	44	80					
Czarna Kuta	0	13	31	23	10	21	31	27	27	40	100	80				
Dgał Mały	0	15	18	13	11	12	18	15	15	25	50	67	50			
Piecek	0	13	31	23	10	21	46	40	40	40	67	80	67	50		
Smolak	0	14	33	25	10	22	33	28	28	44	80	100	80	67	80	

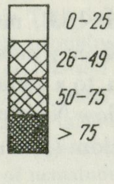

Fig. 4. Diagram of species similarity of groupings of benthic nematodes in central parts of lakes studied (Sörensen index of species similarity is used)

M. similis, *M. macramphis* and *Eudorylaimus carteri*) occurred in common. These are cosmopolitic species occurring in the majority of countries of Northern hemisphere (Gerlach and Riemann 1974).

Chromadorita leuckarti is also a common species, found in Char Lake, which occurs widely in eutrophic lakes, mainly in the littoral zone (Schneider 1922, Prejs 1970), but was not found in Tatra lakes (Liebermann 1931, Stefański 1936, 1938, K. Prejs – unpublished data).

The comparison of Tatra oligotrophic lakes with lowland mesotrophic and moderately eutrophic lakes show the co-occurrence in both types of lakes of *Tobrilus gracilis*, *Monhystera paludicola*, *Ethmolaimus pratensis* and *Ironus tenuicaudatus*. Two first species are the most ubiquitous among 42 species of nematodes found in the lakes studied (Table IV). The fact that these are nearly the only species occurring in profundal of highly eutrophic and dystrophic lakes may suggest that they are best adapted to the limitation or even lack of oxygen in the environment. The dominance of these two species in deeper parts of Danish eutrophic lakes was also found by M i c o l e t z k y (1925). S c h i e m e r, L ö f f l e r and D o l l f u s s (1969) said that *T. gracilis* can be an index of poor oxygen conditions in bottom sediments. This species penetrated the deepest layer of mud and was found even in anaerobic zone of Lake Neusiedler (Austria) by the above mentioned authors.

4. DISCUSSION

A decrease of the species diversity of nematodes with the advancement of lake trophy, found in this paper, agrees with general regularities of the occurrence of bottom fauna in lakes. Usually typical littoral species in oligotrophic lakes occur much deeper than in eutrophic ones, where the oxygen content in the near bottom water, especially during the summer stagnation, is very low (K e n d e i g h 1974).

G i z i ń s k i (1974) found that the amount of oxygen dissolved in water is a one of factors deciding about the abundance of profundal macrofauna in eutrophic lakes. In the case of extremely low oxygen concentrations, numbers of fauna are usually very low; number of species is also reduced. With very high oxygen concentrations the species composition is rich and numbers high. The moderate eutrophic lakes are characterised usually by greater number of species and more numerous fauna than lakes with advanced eutrophy. The author points also to the relation between the abundance of benthic fauna and water movements which depend on lake morphometry. He says that profundal fauna can be very abundant in well mixed lakes with advanced trophy, where there are no conditions for long lasting micro-stratifications. The nematofauna of highly eutrophic lakes Czarna Kuta and Dgał Mały seems to confirm G i z i ń s k i ' s (1974) conclusions. First of these lakes – shallow (maximum depth 3.6 m, mean depth 1.3 m) with surface area 25.2 ha had relatively high number of nematodes (16,000 of individuals per 1 m^2); the second one – much deeper (maximum depth 15.8, mean depth 4.3 m), with surface area nearly twice smaller and with shores protected from winds, had very low numbers of nematodes (500 individuals per 1 m^2). This could explain, to a certain degree, high numbers (up to 100,000 of individuals per 1 m^2) in a large and shallow Neusiedler Lake, where the mid-lake benthos is under strong influence of wave action (S c h i e m e r, L ö f f l e r and D o l l f u s s 1969).

Surely the oxygen conditions and water movements can not be the only factors influencing the distribution of benthic fauna. The food is another important factor. The statement by L u n d b e c k (1926), that "a species appears when it has enough food, and disappears when oxygen conditions make its occurrence imposible" speaks very well about numbers and biomass of macrobenthos in oligotrophic and eutrophic lakes.

The numbers and biomass of profundal macrofauna in oligotrophic lakes is usually much lower than in eutrophic ones with fairly good oxygen conditions (B e r g 1938). The case of the abundance of nematodes in both types of lakes looks different. Generally higher numbers and biomass of nematodes in oligotrophic than in eutrophic lakes, found in this paper, is confirmed by data for two oligotrophic lakes in Austria and Finland (B r e t s c h k o 1973, H a k a et al. 1974). It seems that the low content of organic matter in bottom sediments of oligotrophic lake, which is, among the others, a factor limiting the abundance of macrofauna, is less important for nematofauna. It can be supposed on the basis of morphology of nematode buccal cavity, that they utilize a different, smaller food fraction, poorly available for larger benthic forms.

5. CONCLUSIONS

1. Maximum numbers and biomass of nematodes were found in profundal of oligotrophic lakes, minimal – in lakes with advanced eutrophy and in dystrophic ones.

2. With the advancing trophy the species diversity of nematodes decreases.

3. The most ubiquitous species (among 42 found in studied lakes) are *Tobrilus gracilis* and *Monhystera paludicola*. They occur as nearly the only ones in the profundal of lakes with advanced eutrophy and of dystrophic ones.

4. The low concentration of oxygen near the bottom is probably a main factor limiting the distribution of nematodes in profundal of eutrophic lakes.

5. Analysis of nematode groupings in lakes of different trophic types showed that species diversity can be used for the evaluation of lake trophy, and even can be an index of the lake degradation processes.

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6. SUMMARY

The species diversity, numbers and biomass of benthic nematodes in central parts of 17 lakes with different trophy were studied (Table I). The greatest numbers, biomass and number of nematode species were found in two oligotrophic lakes: Zielony Gąsienicowy and Char, the lowest – in lakes with advanced eutrophy and in dystrophic ones (Figs. 1, 2).

With the advancement of trophy (from oligo- to eutrophy) the species diversity of nematodes, expressed by Shannon index of species diversity (H), decreased. A correlation (with $r = -0.84$) was found between the species diversity index and trophy of studied lakes (Figs. 3).

Three groups of lakes similar as far as nematode species composition was concerned were distinguished: I. oligotrophic Tatra lakes, II. lowland with advanced eutrophy and dystrophic, III. mesotrophic and these with moderate eutrophy (Fig. 4).

Tobrilus gracilis and *Monhystera paludicola* were the most ubiquitous species among 42 nematode species found in studied lakes. These species occurred as nearly only ones in profundal of highly eutrophic and dystrophic lakes (Table IV).

It can be supposed that low concentration of oxygen in near bottom waters is a main factor limiting the distribution of nematodes in profundal of eutrophic lakes.

7. POLISH SUMMARY (STRESZCZENIE)

Badano zróżnicowanie gatunkowe, liczebność i biomasę nicieni bentosowych w śródjezierzu 17 zbiorników o różnej trofii (tab. I). Najwyższą liczebność, biomasę i liczbę gatunków nicieni notowano w dwóch zbiornikach oligotroficznych: Zielonym Gąsienicowym i Char, najniższe wartości – w jeziorach silnie zeutrofizowanych i dystroficznych (fig. 1, 2).

W miarę wzrostu trofii (od oligo- do eutrofii) stwierdzono zmniejszanie się zróżnicowania gatunkowego nicieni wyrażonego wskaźnikiem zróżnicowania gatunkowego Shannona ($\bar{H}$). Stwierdzono korelację (przy $r = -0{,}84$) między wielkością wskaźnika zróżnicowania gatunkowego nicieni a trofią badanych jezior (fig. 3).

W badanym materiale wyróżniono trzy grupy jezior podobnych do siebie pod względem składu gatunkowego nicieni: I – oligotroficzne jeziora tatrzańskie, II – nizinne, silnie zeutrofizowane i dystroficzne, III – mezotroficzne i umiarkowanie eutroficzne (fig. 4).

Spośród 42 gatunków nicieni stwierdzonych w badanych jeziorach najbardziej ubikwistycznymi są *Tobrilus gracilis* i *Monhystera paludicola*. Występowały one jako niemal jedyne w profundalu jezior silnie zeutrofizowanych i dystroficznych (tab. IV).

Można sądzić, że głównym czynnikiem ograniczającym rozprzestrzenianie się nicieni w profundalu jezior eutroficznych jest niska koncentracja tlenu przy dnie.

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