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Density and biomass of *Ephemeroptera* larvae in Lake Zbęchy (the Poznań region)*

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Abstract — In the eutrophic Lake Zbęchy the occurrence of seven mayfly species with *Caenis horaria* (L.) and *Cloeon dipterum* (L.) predominating, was observed. The highest values of density and biomass were found in the eulittoral, especially in *Phragmitetum communis* community, and the lowest values at a depth of 2 m.

The mean density and biomass for the entire lake were determined and the vertical migration of *Caenidae* larvae was shown.

Key words: eutrophic lake, mayflies, dominance structure, density, biomass.

1. Introduction

The work contains a part of the results of a complex research project carried out by the Department of Agrobiology of the Polish Academy of Sciences, Poznań. The aim of the study was the evaluation of energy flow and matter cycling in various ecosystems of the agricultural landscape (Ryszkowski 1980).

Among the subjects of the investigation was the eutrophic and polymictic Lake Zbęchy (46 km south of Poznań) with a surface area of 108.9 ha. Its maximum depth reaches 7.5 m, with a mean depth of 4.2 m. It is 2610 m in maximum length and 725 m in maximum breadth. In 1978 the mean oxygen content in water varied from 6.5—11.9 $mg \cdot dm^{-3}$ (Kardaszewicz 1980) and the mean content of dissolved organic

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compounds reached 93.5 $mg \cdot dm^{-3}$ (Życzyńska-Bałoniak 1980).

The majority of the banks is covered by emerged plants, chiefly reed community *(Phragmitetum communis)*. These cover about 11% of lake surface (12 ha). Only a small part of the shore line (10%) is free of emerged macrophytes (Gołdyn, unpublished data). The lake is bordered on by field and, from the south, buildings of the village Zbęchy. In most cases a narrow belt of meadows surrounds the banks of the lake.

In the present work the qualitative composition of *Ephemeroptera* larvae and the structure of their domination were investigated, with special reference to the evaluation of their density and biomass, both in separate habitats and in the lake, taken as a whole.

2. Method

After a preliminary inquiry in the year 1976, regular field investigations were carried out in 1977 and 1978. In 1977 samples were taken from April 4 to December 6, and in 1978 from May 15 to September 28. The investigation included a reed community *(Phragmitetum communis)* at a depth of 0.5 m with a sandy-muddy bottom covered with detritus in 1977 and overgrown by *Fontinalis antypyretica* L. in 1978; a shallow littoral area (0.5 m in depth) with a sandy bottom in summer overgrown by *Potamogeton pectinatus* L. and *Nitellopsis obtusa* (Desvaux) J. Groves (Gołdyn, unpublished data); and littoral areas with sandy-muddy (1 m) and muddy (2 m) bottoms, without vegetation. The depth of 2 m was near the lower line of occurrence of *Ephemeroptera* larvae.

In collecting samples at a depth of 0.5 m, a high metal frame of a section surface of 225 cm^2 was sunk into the bottom, the animals being taken out with a sampler of 0.3 mm mesh net. In deeper parts of the littoral zone the samples were collected with an Ekman dredge (217.5 cm^2). The collected animals were washed on a 0.3 mm mesh sieve and immediately selected. Six to 8 series of samples (4 samples in each series) were taken from the individual habitats. The mean number of larvae in each series was calculated per 1 m^2.

The Beklemišev curve (Tarvid 1956) was used for determining the faunistic representativeness of the collected quantitative samples. Species domination was calculated on the basis of mean density values found during the investigation period.

In designating larvae their length (without the setae) was measured, which permitted to distinguish four size classes. The smallest collected larvae were 1.4 mm in length. As the minimum size limit of the largest larvae, the length of the oldest stage of males, always smaller than the females was admitted. A series of measurements served as basis for

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Table I. Mean values of fresh biomass in the determined size classes of Baetidae and Caenidae larvae

Size class	Baetidae		Caenidae	
	length mm	mg	length mm	mg
I	<2.7	0.40	⩽2.0	0.27
II	2.8 - 4.0	1 10	2.1 - 3.0	0.52
III	4.1 - 5.5	2.00	3.1 - 4.0	1.10
IV	>5.6	4.60	>4.1	3.00

calculating the mean fresh biomass, exact to 0.01 mg (Table I), for the determined size classes of *Baetidae* and *Caenidae*. Its value was used to reckon the amount of biomass (in $mg \cdot m^{-2}$) in different habitats and during different periods of the investigation. The mean values of density and biomass for the littoral to a depth of 2.5 m, and for the lake as a whole were also calculated. For this aim, weighed averages of these values were calculated for the determined depth zones (in hectares), in relation to the littoral area and to the over-all lake surface. Their totals represent the mean values of density and biomass.

Simultaneously, the applied method of indirectly calculating the amount of biomass was checked upon by comparing the obtained values with results found by way of direct weighing. The analysis was carried out on the example of three runs of samples taken in *Phragmitetum communis* (greatest density of larvae) in May, July, and September. In two cases the magnitude of error, showing how much the indirectly calculated biomass was overstated (in May) or lowered (in July) in relation to values obtained by direct weighing, was small (Table II), and hence, hardly significant. It was only in September when the larvae were usually small and most specimens were contained near the lower limit of the determined size classes, that the degree of overstating the indirectly

Table II. Comparison of biomass values ($mg \cdot m^{-2}$) of Baetidae and Caenidae larvae, the result of calculation and direct weighing (data for Phragmitetum communis in the year 1978)

Date	Biomass calculated	Biomass weighed	Difference $\frac{a-b}{b} \cdot 100$
	a	b	
16.V	9560	9113	+ 4.9
14.VII	11915	12936	- 7.9
28.IX	1157	839	+37.9
Mean	7544	7629	- 1.1

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calculated biomass was relatively high (37.9%). However, in that last month the amount of biomass was fairly low and, therefore, in the above-quoted periods of the investigation the average magnitude of error indicated a slight lowering (1.1%), insignificant for the evaluation of the mean value of biomass throughout the season.

3. Results

3.1. The domination structure

In the reed association, on the bottom covered with detritus, species of the family *Caenidae* (69.5%), particularly *Caenis horaria* and *C. luctuosa*, prevailed. A considerably smaller group of *Baetidae* (30.4%) almost entirely consisted of *Cloeon dipterum* (Table III). In this association, on the bottom chiefly covered with *Fontinalis antipyretica*, phytophilous

Table III Composition and percent structure domination of Ephemeroptera in Lake Zbęchy

Taxons	Red community 0.5 m		Bottom			Lake as a whole
	Detritus	Fontinalis	sandy 0.5 m	sandy-muddy 1 m	muddy 2 m	
	1977	1978	1978	1977	1977	
Cloeon dipterum (L.)	30.3	48.2	27.2			36.8
Centroptilum luteolum (Müll.)	0.1	10.8	8.4			5.4
Cloeon simile Etn.		0.1				0.1
Baetidae	30.4	59.1	35.6			42.2
Caenis horaria (L.)	38.3	32.7	50.9	54.1	74.0	37.6
Caenis luctuosa (Burm.)	30.5	7.5	13.2	42.9	24.7	19.4
Caenis robusta Etn.	0.7	0.7	0.3	3.0	1.3	0.8
Caenidae	69.5	40.9	64.4	100.0	100.0	57.8
Paraleptophlebia sp.	0.1					<0.1

species of the family *Baetidae* (59.1%) predominated, *C. dipterum* being an outstanding dominant. Simultaneously, a high increase in *Centroptilum luteolum* domination were observed.

On the sandy bottom (0.5 m) which periodically was overgrown with macrophytes, *Caenidae*, particularly *C. horaria* (50.9%) prevailed. High domination was only reached by *Baetidae* in period of the most abundant development of macrophytes.

On the bottom without macrophytes, at depths of 1 and 2 m, the only species to occur were those of the family *Caenidae* with *C. horaria* as a dominant (54.1 and 74.0%) occurred. High values of domination of this

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species in different habitats of the investigated lake suggest that it is a highly eurytopic species. It also predominated in the mayfly fauna of the whole lake (37.6%). In spite of the distribution of *Cloeon dipterum* on a considerably smaller section of the lake surface, its general domination was only slightly smaller (36.8%) due to large numbers reached by this species in the phytolittoral.

The domination of individual mayfly families and species in the lake chiefly depended upon the type of habitat, and especially on the occurrence of submersed macrophytes, as well as on the depth (Table III).

3.2. Density and biomass

3.2.1. The density and biomass in phytolittoral at a depth of 0.5 m

The largest values of maximum and mean densities and biomass were found in the *Phragmitetum communis* association, both on the bottom covered by detritus and on that overgrown by *Fontinalis* (Table IV A, B). In spite of various periods of the investigation, mean densities of mayfly larvae were fairly similar in these two habitats. However, in the year 1978 the values of maximum and mean biomass almost doubled (Table IV B) as compared with values found in 1977 (Table IV A). In 1978, when the bottom was overgrown by *Fontinalis,* these differences were brought about by much larger numbers of phytophilous *Baetidae* larvae whose mean biomass was larger than that of *Caenidae* representatives.

Table IV. Density (N - specimens.m^{-2}) and biomass (B - mg.m^{-2}) of Ephemeroptera larvae in Phragmitetum communis association with bottom covered with detritus in 1977 or with bottom mostly overgrown by Fontinalis antipyretica in 1978

Date		Baetidae		Caenidae		Leptophlebiidae		Ephemeroptera	
		N	B	N	B	N	B	N	B
1977 (A)	4.IV	33	37	322	181	-	-	355	218
	4.V	11	12	522	430	-	-	533	442
	28.VI	200	450	322	581	-	-	522	1031
	26.VIII	345	161	1344	554	-	-	1689	715
	5.X	1033	1470	2767	1585	22	18	3822	3073
	19.X	1733	2839	7055	3286	-	-	8788	6125
	11.XI	2955	5129	500	208	-	-	3455	5337
	6.XII	289	368	2278	1240	-	-	2567	1608
	Mean	825	1308	1889	1008	3	2	2717	2318
1978 (B)	16.V	389	1219	3000	3760	-	-	3389	4979
	6.VI	44	175	2111	3823	-	-	2155	3898
	28.VI	1878	3598	911	1810	-	-	2789	5408
	14.VII	7199	11788	578	1148	-	-	7777	12936
	1.VIII	556	1259	578	870	-	-	1134	2129
	28.VIII	1478	956	133	127	-	-	1611	1083
	28.IX	900	730	1300	523	-	-	2200	1253
	Mean	1778	2818	1230	1723	-	-	3008	4541

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Moreover, in the year 1977, spring and the beginning of summer were characterized by high water level, this enabling the migration of mayflies to the shore line of the lake and their gathering among submersed grasses and sedge *(Carex)*. Mostly, the oldest larval stages appeared there. Therefore, in the *Phragmitetum communis* association the number of larvae and especially their biomass were lower in this period (Table IV A) than in the corresponding period of 1978. In the latter, the water level was lower by 40 cm and the water line went across the sandy bottom, this ruling out any gathering of larvae near the shore. The largest values of density and biomass were found in July (Table IV B) and October (Table IV A).

On the sandy bottom, periodically overgrown by submerged vegetation, the mean density of mayfly larvae and the mean amount of biomass were lower by 2.7—2.9 and 1.2—2.3 than the corresponding figures in the *Phragmitetum communis* association. This was due to the shorter period of occurrence of *Baetidae* larvae, coinciding with the period of abundant development of macrophytes, and, in spring and autumn, when there were no macrophytes, to increased effect of water waving, limiting the numbers of *Caenidae* larvae on the bottom. In this habitat the highest values of density and biomass were found in midsummer (Table V A).

Table V. Density (N - specimens.m^{-2}) and biomass (B - mg.m^{-2}) of Ephemeroptera larvae at a depth of 0.5 m on sandy bottom periodically overgrown with macrophytes in 1978, at a depth of 1 m on sandy-muddy bottom without macrophytes in 1977, and at a depth of 2 m on muddy bottom without macrophytes in 1977. x - no samples taken

Data	Depth 0.5 m (A)						Data	Depth			
	Baetidae		Caenidae		Ephemeroptera			1 m (B) Caenidae		2 m (C) Caenidae	
	N	B	N	B	N	B		N	B	N	B
15.V	-	-	178	153	178	153	13.IV	184	100	265	130
6.VI	-	-	844	1360	844	1360	4.V	276	130	92	55
28.VI	1044	2202	433	1082	1477	3284	31.V	575	950	-x	-x
14.VII	1155	3493	778	567	1933	4060	28.VI	92	110	46	51
1.VIII	289	1059	2111	3918	2400	4977	26.VIII	103	28	207	56
23.VIII	56	71	178	183	234	254	5.X	299	166	138	69
28.IX	-	-	78	59	78	59	11.XI	426	349	92	45
Mean	363	975	657	1046	1020	2021	Mean	279	262	140	68

3.2.2. Density and biomass on the bottom without macrophytes at depths of 1 and 2 m

With no macrophytes at the depths of 1 and 2 m, mayfly larvae were represented by *Caenidae* only. At the depth of 1 m their mean density was lower by 3.7—10.8 (Table V B) as compared with that in phytolittoral (Tables IV A, B, V A), and by 2.4—6.8 in relation to *Caenidae* only. The mean amount of biomass was lower by 7.7—17.3 and in relation to *Caeni-*

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dae — by 3.8—6.6. The highest values of density and biomass were found by the end of May, fairly high values being noted in November.

At the depth of 2 m, a further decrease in mean density and biomass was observed (Table V C). As compared with data obtained at the depth of 1 m, the mean density was lowered to 1/2 and the amount of biomass to 1/4. The highest values were found in April (Table V C).

3.2.3. Estimate of mean density and biomass in the littoral and in the entire lake

The fairly high values of density and biomass of mayfly larvae, calculated for the littoral (Table VI A) and for the entire lake (Table VI B), are chiefly the effect of the results obtained in the phytolittoral, especially in the *Phragmitetum communis* association. In the littoral, down to 2.5 m (28.5 ha), which constituted 26.2% of lake surface, the mean density reached 1445.5 specimens $\cdot$ m^{-2} and the amount of biomass 1717.7 mg $\cdot$ m^{-2}. These values were lower by 3.8 in relation to the entire lake surface (Table VI B). However, they were fairly high, giving 4.5 kg per 1 ha and 490 kg biomass for the entire lake. The mean amount of biomass of *Caenidae* larvae (42.8%) was lower than that of *Baetidae* (57.2%), yet they constituted the more important group of mayflies in the biology of the lake because of their greater role in the mineralization of detritus and in the food of Cyprinid fishes.

Table VI. Mean density (N - specimens.m^{-2}) and biomass (B - mg.m^{-2}) of Ephemeroptera larvae in the investigation period (1977 and 1978) in different depth zones: a - littoral of Lake Zbęchy in relation to the whole area of littoral (to the depth of 2.5 m) and in the whole littoral; b - entire lake in relation to its area, and in the whole lake.
x - Total densities and biomass of Baetidae, Caenidae and Leptophlebiidae whose percent does not exceed 0.1; xx - zone with emerged vegetation communis chiefly Phragmitetum association

	Lake zones between isobates (m)	Area of the zone (ha)	Baetidae		Caenidae		Ephemeroptera^{x}	
			N	B	N	B	N	B
a	0.0 - 0.5^{xx}	8.9	406.4	644.2	487.0	426.7	893.7	1071.0
a	0.0 - 0.5	1.1	14.0	37.6	25.4	40.4	39.4	78.0
a	0.5 - 1.5^{xx}	8.3	189.5	300.4	267.7	237.1	457.4	537.5
a	0.5 - 1.5	1.0	0.0	0.0	9.8	9.2	9.8	9.2
a	1.5 - 2.5	9.2	0.0	0.0	45.2	22.0	45.2	22.0
a	Total	28.5	609.9	982.2	835.1	735.4	1445.5	1717.7
a	%	100.0	42.2	57.2	57.8	42.8	100.0	100.0
b	0.0 - 0.5^{xx}	8.9	106.4	168.6	127.4	111.7	233.9	280.3
b	0.0 - 0.5	1.1	3.7	9.8	6.6	10.6	10.3	20.4
b	0.5 - 1.5^{xx}	8.3	49.5	78.6	70.1	62.1	119.7	140.7
b	0.5 - 1.5	1.0	0.0	0.0	2.6	2.4	2.6	2.4
b	1.5 - 2.5	9.2	0.0	0.0	11.8	5.7	11.8	5.7
b	2.5 - 5.5	80.4	0.0	0.0	0.0	0.0	0.0	0.0
b	Total	108.9	159.6	257.0	218.5	192.5	378.3	449.5
b	%	100.0	42.2	57.2	57.8	42.8	100.0	100.0

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3.3. Vertical migration of *Caenidae* larvae

It was found that in the lake transect (without emerged macrophytes) the maximum and mean values of density of *Caenidae* larvae (Table V A, B, C), the range of mean biomasses, and the mean biomass of specimens in the given season (Table VII) decreased with increasing depth (0.5—2 m). This regularity showed that the imagines of this family laid eggs in a wide zone of lake littoral while the hatched larvae migrated to the shores of the lake during their development, except for winter season. This is also suggested by the curves illustrating the number of larvae at these depths in spring and autumn (fig. 1). At a depth of 0.5 m following

Table VII. Dependence of mean biomass (mg) of Caenidae larvae upon the depth in lake transect (0.5 - 2.0 m) without emerged macrophytes

Habitat	Depth (m)	Range of mean biomasses (mg)	Mean biomass of a specimen in the period of the investigation (mg)
Sandy bottom, periodically overgrown by macrophytes	0.5	0.73 - 2.50	1.59
Sandy-muddy bottom without macrophytes	1.0	0.27 - 1.65	0.94
Muddy bottom without macrophytes	2.0	0.27 - 1.11	0.49

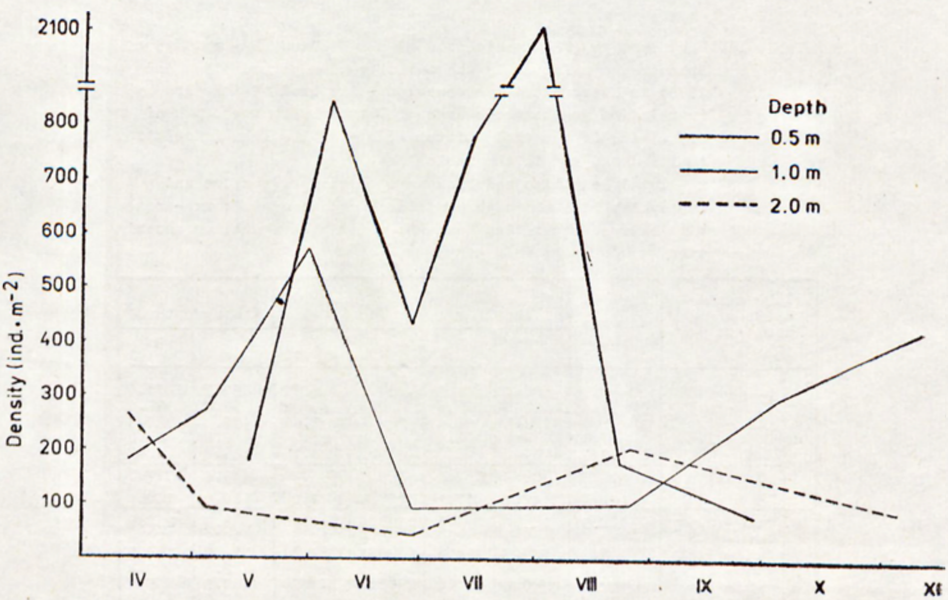

Fig. 1. Changes in the density of *Caenidae* larvae in lake littoral without emerged macrophytes at a depth of 0.5 m in 1978, and at depths of 1 and 2 m in 1977

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a high peak of occurrence of the larvae at the beginning of August, their number rapidly decreased by the end of that month owing, for the most part, to the flight of imagines. However, in September a further decrease in numbers was due to the migration of larvae to the depth of 1 m, where a distinct increase in their number was observed. It can be concluded that this was brought about by the death of submerged macrophytes at the depth of 0.5 m and by the growing effect of water waving on the bottom. However, in the discussed period (autumn) a continuous decrease in the number of larvae was noted at the depth of 2 m. It is possible that the *Caenidae* larvae did not migrate to the depth of 2 m before winter months, since in spring their number there was larger than at depths of 1 m and 0.5 m (fig. 1).

4. Discussion

4.1. General characteristics of mayfly fauna

Most mayfly species develop in rivers, in spring flood waters of rivers, and in old river-beds only. In lakes the qualitative composition of mayfly fauna is usually very poor. Keffermüller (1960) found 42 mayfly species in Great Poland (Wielkopolska), only 11 of them being found in 25 lakes.

In Lake Zbęchy the occurrence of 7 species was noted (Table I). This is a fairly large number, especially for an eutrophic lake with poorly differentiated conditions. One may assume that the species observed represented the entire mayfly fauna of this lake, as the course of the Beklemišev curve (fig. 2) indicates a sufficient number of samples collected

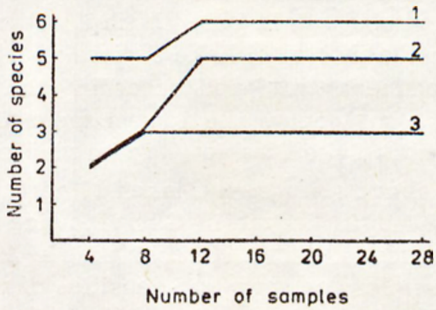

Fig. 2. The Bęklemišev curve showing the faunistic representativeness of quantitative samples. 1 — *Phragmitetum communis* association (depth of 0.5 m); 2 — sandy bottom (depth of 0.5 m) periodically overgrown by macrophytes; 3 — sandy-muddy bottom (depth of 1 m) and muddy bottom (depth of 2 m) without macrophytes

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for the determination of the qualitative composition of these insects (T a r w i d 1956). Of the collected specimens, the larvae of genus *Paraleptophlebia* L e s t. have been the only to be noted in running waters so far. Their appearance was connected with the neighbouring drainage canal. They belong to rare species. Other species are rather common, particularly *Cloeon dipterum* and *Caenis horaria*.

4.2. Density and biomass

In works on the bottom fauna of Polish lakes, mayfly larvae are rarely taken into consideration, either because the littoral, especially its shallow parts, is usually poorly explored, or the investigation is limited to the profundal zone where they no more occur. Sometimes, they are included in a collective group determined as "other invertebrates". Though, in a number of papers data concerning these insects show a relatively high density of their larvae.

According to P i e c z y ń s k a (1972), in the littoral of Lake Mikołajki the highest density of mayfly larvae reached 1630 specimens $\cdot$ m^{-2}. S o s z k a (1975) reported as many as 7454 specimens $\cdot$ m^{-2} (23% of invertebrates); the average, however, was low (268 specimens $\cdot$ m^{-2}). A relatively high density was also found in the bay part of Lake Gopło: 1108 specimens $\cdot$ m^{-2}, with an average of 403 specimens $\cdot$ m^{-2} (G i z i ń s k i, T o c z e k - B o r u c h o w a 1972).

Other authors have reported very small numbers of mayfly larvae only. G i z i ń s k i, K a d u l s k i (1972) investigated the horizontal differentiation of Lake Gopło bottom fauna at depths from 1.5—15 m, and at a depth of 1.5 m found the greatest mean density of mayfly larvae, reaching 71 specimens $\cdot$ m^{-2}, i.e. one third of the value noted in the corresponding zone of Lake Zbęchy. The density found by these authors at the depth of 2 m (33 specimens $\cdot$ m^{-2}) reached only one fourth of the number noted at the same depth in Lake Zbęchy. According to W o l n o m i e j s k i (1965), in the littoral of Lake Jeziorak Mały the highest density reached 172 specimens $\cdot$ m^{-2} and according to G i z i ń s k i et al. (1968), 75 specimens $\cdot$ m^{-2} only. The lowest mean density of 2 specimens $\cdot$ m^{-2} was found in Lake Płaskie (G i z i ń s k i et al. 1968).

The data quoted above refer to the lakes of northeast Poland. In the south, the density of mayfly larvae in Goczałkowice reservoir was also very low (132 specimens $\cdot$ m^{-2}, K r z y ż a n e k 1970). In a period covering several years low or very low densities of mayfly larvae have been found by the above authors, and no calculations concerning regularities in their occurrence were suggested.

The qualitative and quantitative decrease in mayfly fauna noted at greater depths in Lake Zbęchy supported the results of R z ó s k a (1935,

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1936) in Lake Kierskie near Poznań. Rzóska found the highest density of 2660 specimens $\cdot$ m^{-2} on the average, with a maximum of 15 400 specimens $\cdot$ m^{-2}, in upper littoral (0.1—3 m), followed by a decrease to very small numbers at a depth of 7—9 m. This high density of mayfly larvae and their high frequency in samples taken at a depth of 8.8 m (79%), led Rzóska to the right conclusion that they were an important group in the "lake life".

The regularity of vertical decrease in the qualitative and quantitative composition in mayfly fauna was also found by Ökland (1964) in Lake Borrevann in the south of Norway. The values of mean density ranged from 1416 specimens $\cdot$ m^{-2} at a depth of 0.2 m to 9 specimens $\cdot$ m^{-2} at a depth of 3 m, with mean biomass values of 5 g $\cdot$ m^{-2} — 0.01 g $\cdot$ m^{-2}, respectively.

As compared with mean biomass values found in Lake Zbęchy and to those reported by Ökland (1964), the values claimed by Kajak and Dusoge (1975) for the depth of 4 m (about 10 and 6% of total values which amounted to 21.5 and 19.7 g $\cdot$ m^{-2}, i.e. 2.1 and 1.2 g $\cdot$ m^{-2}) seem over-estimated for this depth.

Very few data can be found in the literature concerning the biomass of the discussed insects. Probably, this is chiefly due to the fact that the individual mean biomass for the different size classes has not been elaborated in detail so far. Szumiec (1961, 1963) quoted the value of 0.3—14.0 mg biomass for three size classes of mayfly larvae: 1—3, 3—8 and 8—13 mm. The first two classes relate to *Baetidae* and *Caenidae* larvae only. Results obtained on the basis of such calculations contain an error much larger than those derived from mean biomass determined for four classes of magnitude and for each of these families separately (Tables I, II).

5. Conclusions

High values of density and biomass of mayfly larvae found in Lake Zbęchy and, simultaneously, a pronounced domination of the most eurytopic species, *Caenis horaria* and *Cloeon dipterum* (together 74.4%) point to the typical eurytopic character of this lake.

The inflow of pollution in the form of organic substances from a neighbouring village, is insignificant and moderated by the flowing character of the lake and, it can be assumed, by its great efficiency in decomposing these substances. This is shown by the occurrence of *Centroptilum luteolum* (5.4% on the average and 10.8% in some places), a species characteristic of the beta-mesosaprobic waters, and, to a lesser degree, of the oligosaprobic ones, while it is absent from polysaprobic waters (Zelinka 1969).

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6. Polish summary

Zagęszczenie i biomasa larw *Ephemeroptera* w jeziorze Zbęchy (region poznański)

W latach 1977—1978 stwierdzono w jeziorze Zbęchy występowanie larw 7 gatunków jętek, co stanowi dobrą reprezentację fauny tych owadów dla jeziora eutroficznego (ryc. 2). Gatunkami dominującymi w całym jeziorze były *Caenis horaria*, występująca w całym litoralu, i *Cloeon dipterum*, ograniczony do fitolitoralu (tabela III).

Fitolitoral, zwłaszcza z zespołem *Phragmitetum communis*, cechowały największe wartości maksymalnego i średniego zagęszczenia larw oraz stanów ich biomasy (tabele IV, VA). Stany biomasy (w $mg \cdot m^{-2}$) wyliczone metodą pośrednią po uprzednim wyznaczeniu średnich wartości biomas dla czterech klas wielkości larw *Baetidae* i *Caenidae* (tabela I) wykazały ogólnie wysoki stopień zgodności z wynikami otrzymanymi metodą bezpośredniego ważenia (tabela II).

Największe wartości zagęszczenia larw jętek oraz odpowiadające im zwykle wysokie stany biomasy występowały w poszczególnych środowiskach w różnych miesiącach (tabele IV, V), co wynika nie tylko z różnic w składzie gatunkowym larw tych owadów i ich biologii rozwoju, lecz także z sezonowych wędrówek larw *Caenidae*.

W transekcie jeziora bez wynurzonych makrofitów na głębokościach 0,5, 1 i 2 m stwierdzono gwałtownie postępujący spadek średniego zagęszczenia oraz stanów biomasy (tabela V, ryc. 1). Ze wzrostem głębokości malała też średnia biomasa osobnicza larw *Caenidae* oraz zakres tych biomas w okresie badań (tabela VII), co wskazuje na stałe ich przemieszczenie się w kierunku brzegów jeziora z wyjątkiem miesięcy zimowych, kiedy gromadzą się głównie na głębokości 2 m. Na tę prawidłowość wskazywało też obserwowane w okresie wiosenno-letnim gromadzenie się najstarszych stadiów larwalnych przy linii brzegowej porośniętej przez makrofity.

Wysokie wartości zagęszczenia larw jętek w fitolitoralu wpłynęły na uzyskanie stosunkowo wysokich średnich wartości zagęszczenia i stanu biomasy dla całego litoralu (tabela VI A) oraz dla całego jeziora (tabela VI B). Wielkość tych wartości oraz wysoka dominacja *Caenis horaria* i *Cloeon dipterum* wskazują na typowo eutroficzny charakter badanego jeziora.

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