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Ryszard KORNIJÓW

Agricultural Academy, Department of Zoology and Hydrobiology, Akademicka 13, 20-934 Lublin, Poland

MACROFAUNA OF ELODEIDS OF TWO LAKES OF DIFFERENT TROPHY. II. DISTRIBUTION OF FAUNA LIVING ON PLANTS IN THE LITTORAL OF LAKES

ABSTRACT: The studies were conducted on the occurrence of invertebrate fauna colonizing: *Myriophyllum alternifolium*, D. C., *Ceratophyllum demersum* L. and *Potamogeton lucens* L. in different types of littoral and at different depths in mesotrophic Lake Piaseczno and in eutrophic Lake Głębokie. Differences between the fauna colonizing different types of littoral in mesotrophic lake concerned mainly its species composition and dominance structure, whereas in the eutrophic lake – its density and biomass especially in relation to bottom surface. The influence of depth on invertebrates was mainly reflected by their species composition and dominance structure, and was very distinct in the eutrophic lake.

KEY WORDS: epiphytic fauna, elodeids, distribution, lake trophy.

1. INTRODUCTION

Horizontal distribution of fauna living on aquatic macrophytes is not well known (M e s c h k a t 1934, W o l n o m i e j s k i 1969, S o s z k a 1973). There is also very little information about the relations between the depth at which the plants grow and the qualitative and quantitative composition of invertebrates colonizing them (W o l n o m i e j s k i 1969, S o s z k a 1975, H i g l e r 1981). And there are no data on the effect of lake trophy on the distribution of fauna living on plants.

The aim here has been to investigate the vertical and horizontal distribution of fauna living on plants in the mesotrophic and eutrophic lake. Analysis of horizontal distribution of invertebrates was made for fauna colonizing three types of littoral distinguished after B e r n a t o w i c z and Z a c h w i e j a (1966). Thus another attempt was made, following D u s o g e (1966), O p a l i ń s k i (1971) and W o l n o m i e j s k i et al. (1976), to add to the characteristics of littoral types some elements of invertebrate fauna.

2. MATERIAL AND METHODS

This part deals with fauna living on *Myriophyllum alternifolium* and *Ceratophyllum demersum* in Lake Piaseczno, and with *Ceratophyllum demersum* and *Potamogeton lucens* in Lake Głębokie (Łęczna – Włodawa Lakeland, Eastern Poland). Studies in the first lake were conducted in psammolittoral and atrophic phytolittoral at the depth of 0.5, 2 and 4 m, whereas in the other – in marsh and atrophic phytolittoral at the depth of 0.5 and 2 m. Sampling stations and methods applied are described in the first part of this work (K o r n i j ó w 1989).

3. RESULTS

3.1. QUALITATIVE COMPOSITION AND DOMINANCE STRUCTURE

Considerable differences in the qualitative abundance of fauna in Lake Piaseczno colonizing the same elodeids in different types of littoral were observed mainly for Chironomidae (Table 1). On the whole, much more taxons from this group occurred on plants growing in the atrophic phytolittoral than in psammolittoral. Qualitative composition of other groups in both types of littoral was similar. Differences in the species abundance can be due to the depth at which the plants grow and have also concerned mainly the fauna of Chironomidae, but they did not have a directional character as the number of taxons in psammolittoral increased together with the depth, whereas in the atrophic phytolittoral – it decreased (Table 1).

The differences in fauna living on plants in Lake Głębokie in different types of littoral and at different depths concerned mainly Gastropoda and to a smaller extent – Chironomidae (Table 1). In the marsh phytolittoral of this lake there was more taxons, especially on pond weed. Greater differences in fauna were observed in connection with plants occurring at different depths. With the increasing depth qualitative composition of fauna was becoming poorer on both elodeid species (Table 1). Probably in the case of pond weeds, with concentration of leaves close to the water surface, the wave action was the main factor limiting its colonization. The significance of wave action for the distribution of periphytic fauna was indicated by such authors as E n t z (1947), M c G a h a (1952), P i e c z y ń s k a (1972), S k a l s k a j a (1982) and K o ł o d z i e j c z y k (1984).

In the dominance structure of fauna living on plants in Lake Piaseczno considerable differences between littoral types were mainly in the case of invertebrates occurring on water nimfoil growing in the shallowest littoral zones (Fig. 1). In psammolittoral, *Psectrocladius* gr. *psilopterus* Kieff. dominated on this plant, and the only subdominants in this zone were: *Stylaria lacustris* (L.), *Parakiefferiella bathophila* (Kieff.) and *Orthocladius saxicola* Kieff. Whereas in atrophic phytolittoral *Limnochironomus* sp. dominated, and *Ablabesmyia* gr. *lentiginosa* (Fries) and *Cyrnus* sp. were characteristic subdominants for this type of littoral. The influence of depth on

Table 1. Number of taxons of fauna living on elodeids growing in particular types of littoral and at different depths (in metres) in lakes Piaseczno and Głębokie

Taxons	Lake Piaseczno						Lake Głębokie							
	M. alternifolium				*C. demersum*		*C. demersum*				*P. lucens*			
	psammolittoral		atrophic phytolittoral		psammolittoral	atrophic phytolittoral	marsh phytolittoral		atrophic phytolittoral		marsh phytolittoral		atrophic phytolittoral	
	0.5	2	0.5	2	4	4	0.5	2	0.5	2	0.5	2	0.5	2
Naididae	4	5	3	3	4	4	2	1	2	2	2	2	2	2
Trichoptera	3	5	4	5	6	4	4	4	3	3	2	1	1	1
Chironomidae	20	23	30	25	17	24	19	19	20	18	13	10	10	13
Gastropoda	0	1	1	1	2	3	9	5	8	4	6	1	1	0
Others	9	13	8	11	10	11	12	11	12	8	9	13	8	2
Total	36	47	46	45	39	46	46	40	45	35	32	17	22	18
Naididae	6		4		4	4	2			3		2		3
Trichoptera	5		5		6	4	6			5		2		1
Chironomidae	28		34		17	24	21			22		13		13
Gastropoda	1		2		2	3	9			8		6		1
Others	15		15		10	11	14			13		10		9
Total	55		60		39	46	52			51		33		27

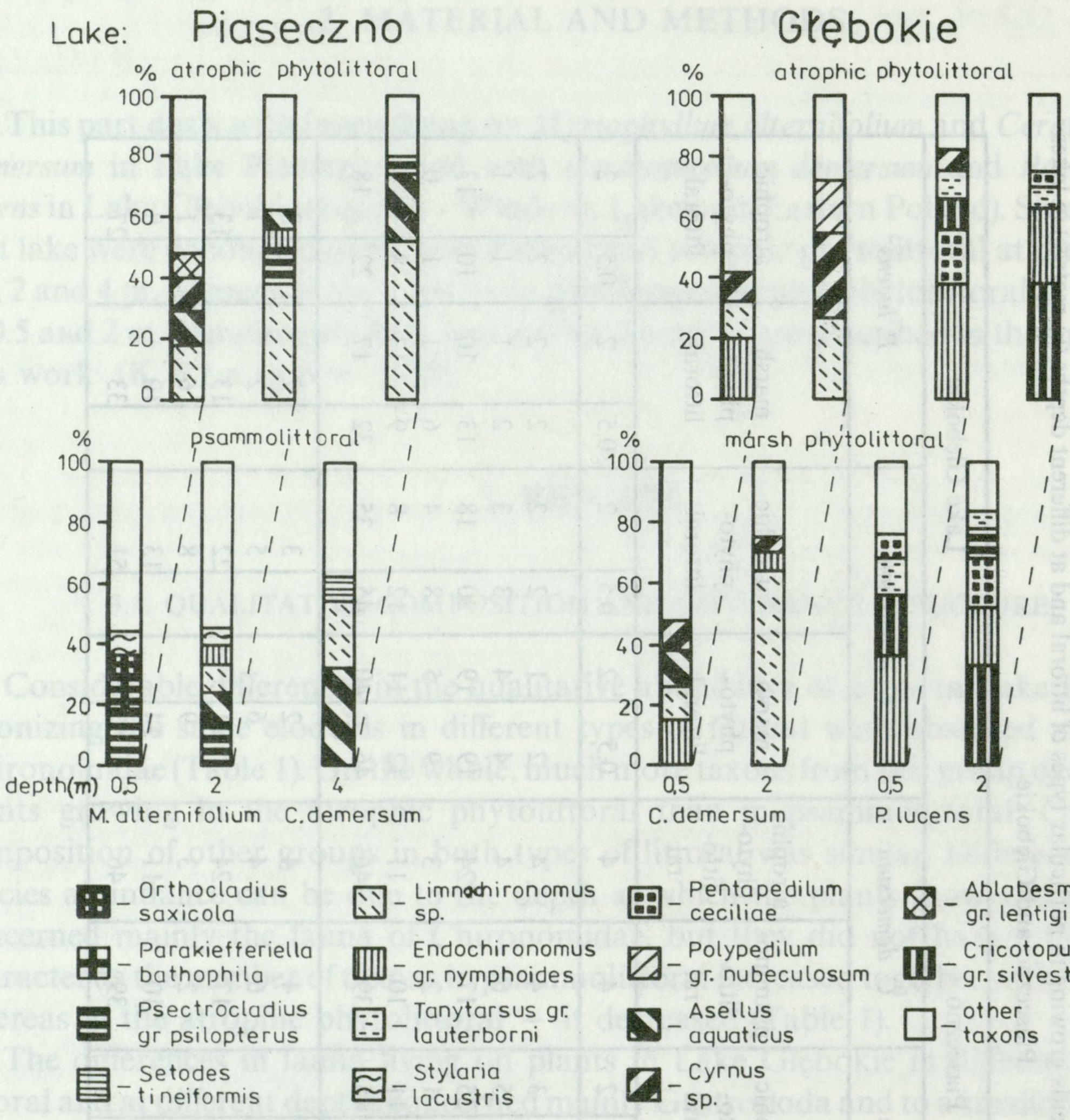

Fig. 1. Dominance structure of fauna colonizing elodeids in different types of littoral and at different depths in lakes Piaseczno and Głębokie. Mean values for the period between January 1983 and December 1984

dominance structure of fauna living on plants (occurring on water nimfoil) resulted in higher percentage of dominant species *Limnochironomus* sp. with the increasing depth. This also concerned – although to a smaller extent – the subdominants (Fig. 1).

In eutrophic Lake Głębokie, the differences between littoral types were poorly indicated by dominance structure of fauna. Small changes in dominance structure of fauna were observed also at different depths; together with increasing depth the dominance of *Limnochironomus* sp. increased, on hornwort and on pond weed – of *Cricotopus* gr. *silvestris* (Fabr.).

3.2. DENSITY AND BIOMASS OF FAUNA IN RELATION TO FRESH PLANT WEIGHT

In Lake Piaseczno the density of fauna living on plants was generally similar in both types of littoral (Fig. 2). Only on water nimfoil, at the depth of 2 m, the density of fauna

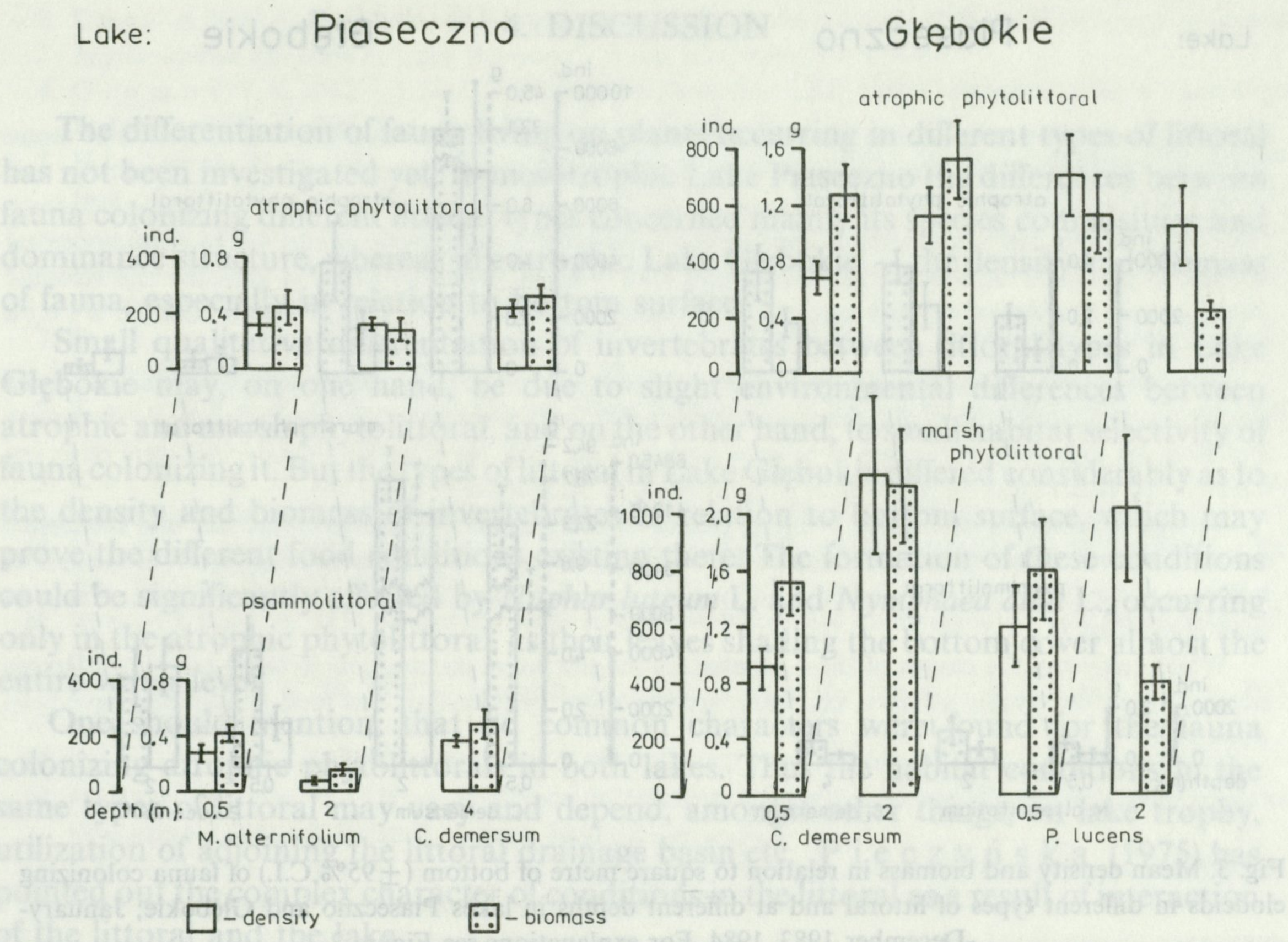

Fig. 2. Mean density and biomass in relation to 100 g fresh plant weight (±95% C.I.) of fauna colonizing elodeids in different types of littoral and at different depths in lakes Piaseczno and Głębokie; January--December 1983, 1984

was statistically higher ($P = 0.02$) in the atrophic phytolittoral than in the psammolittoral. Also at particular depths the density of animals was at a similar level and only on the water nimfoil in the psammolittoral at the depth of 2 m it was lower ($P = 0.02$) than at the depth of 0.5 m. Mean density of fauna in lake Piaseczno did not differ significantly between types of littoral, also no significant relations were found between its biomass and the depth at which elodeids were found (Fig. 2).

In Lake Głębokie statistically significant differences between fauna colonizing different littoral types were observed at the depth of 2 m (Fig. 2). In this zone, both on the hornwort and pond weed, the density of fauna was higher in the marsh phytolittoral ($P = 0.05$). No directional relation was observed between the fauna density and the depth; in the marsh phytolittoral, both on hornwort and pond weed, mean density of animals was higher ($P = 0.05$) at the depth of 2 m than at the depth of 0.5 m, whereas in the atrophic phytolittoral on hornwort the density at depths examined did not differ statistically significantly, and on pond weed the fauna at the depth of 0.5 m had higher density than at the depth of 2 m ($P = 0.05$).

In the biomass of fauna a significant difference between types of littoral was observed only on pond weed growing at the depth of 2 m (Fig. 2); here the biomass in the marsh phytolittoral was higher ($P = 0.05$) than in the atrophic one. Generally the

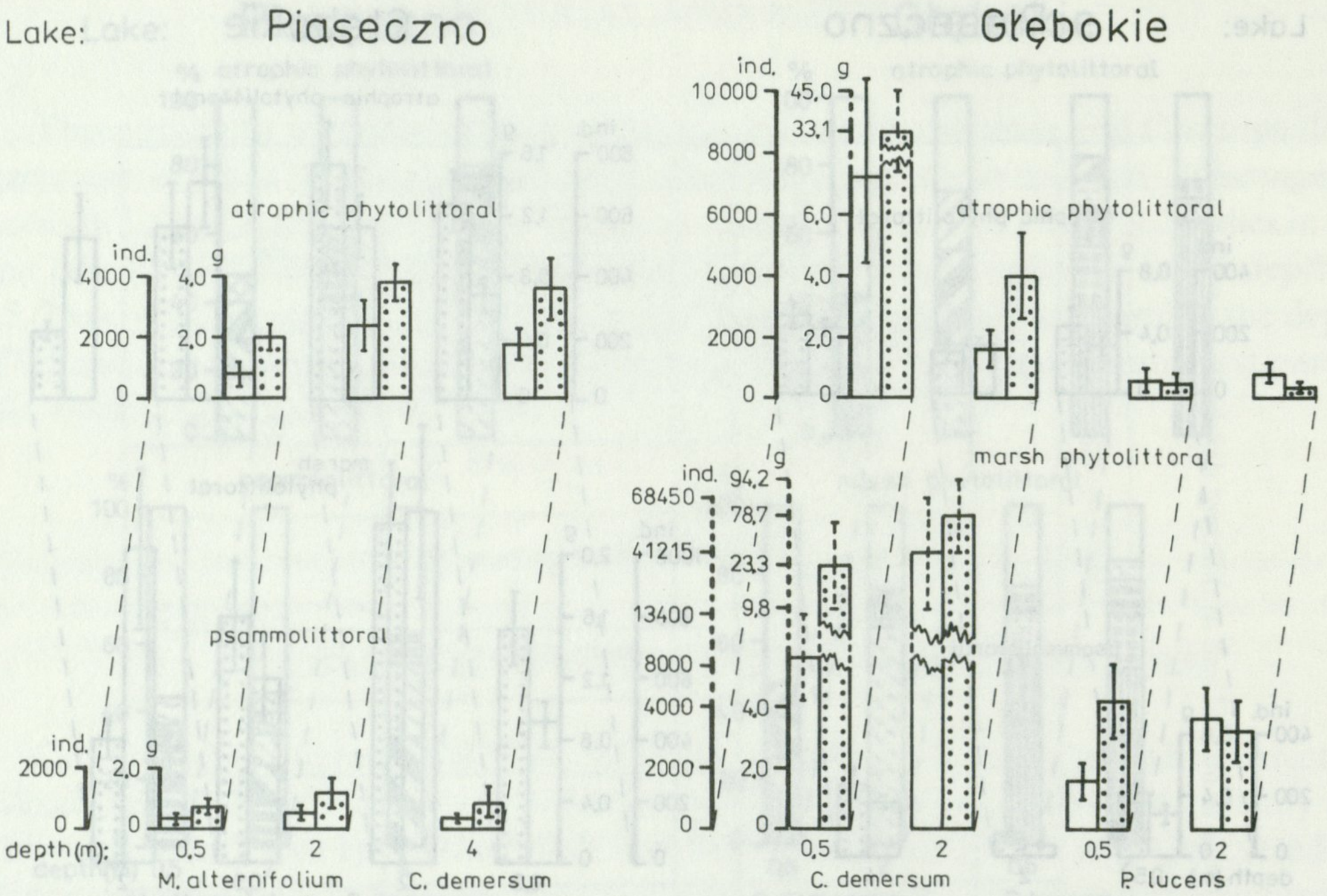

Fig. 3. Mean density and biomass in relation to square metre of bottom (±95% C.I.) of fauna colonizing elodeids in different types of littoral and at different depths in lakes Piaseczno and Głębokie; January-December 1983, 1984. For explanations see Figure 2

biomass of invertebrates did not show any relation to the depth at which the plants grew. Only in the atrophic phytolittoral the biomass on pond weed at the depth of 0.5 m was statistically significant ($P = 0.02$) and higher than at the depth of 2 m.

3.3. DENSITY AND BIOMASS OF FAUNA IN RELATION TO SQUARE METRE OF BOTTOM

The density and biomass of fauna in relation to square metre of bottom depended first of all on the quantitative abundance of macrophytes in lake zones examined. In Lake Piaseczno much higher density and biomass ($P = 0.02$) of fauna was recorded in the atrophic phytolittoral than in the psammolittoral (Fig. 3). With the increasing depth the density and biomass of invertebrates living on hornwort increased in both types of littoral.

In Lake Głębokie a much higher density and biomass ($P = 0.01$), both on hornwort and pond weed, was attained by fauna in marsh phytolittoral than in the atrophic one (Fig. 3). In the marsh phytolittoral the density and biomass of fauna on both plant species increased together with the depth, whereas in the atrophic phytolittoral an inverse regularity was observed, and the density and biomass of fauna on pond weed remained at a similar level independently of the depth (Fig. 3).

4. DISCUSSION

The differentiation of fauna living on plants occurring in different types of littoral has not been investigated yet. In mesotrophic Lake Piaseczno the differences between fauna colonizing different littoral types concerned mainly its species composition and dominance structure, whereas in eutrophic Lake Głębokie – the density and biomass of fauna, especially in relation to bottom surface.

Small qualitative differentiation of invertebrates between littoral types in Lake Głębokie may, on one hand, be due to slight environmental differences between atrophic and marsh phytolittoral, and on the other hand, to small habitat selectivity of fauna colonizing it. But the types of littoral in Lake Głębokie differed considerably as to the density and biomass of invertebrates in relation to bottom surface, which may prove the different food conditions existing there. The formation of these conditions could be significantly affected by *Nuphar luteum* L. and *Nymphaea alba* L., occurring only in the atrophic phytolittoral, as their leaves shading the bottom cover almost the entire water level.

One should mention, that no common characters were found for the fauna colonizing atrophic phytolittorals in both lakes. Thus the habitat conditions in the same types of littoral may vary and depend, amongst other things, on lake trophy, utilization of adjoining the littoral drainage basin etc. P i e c z y ń s k a (1975) has pointed out the complex character of conditions in the littoral as a result of interaction of the littoral and the lake.

Data on the relation between fauna living on plants and the depth at which the elodeids grow are very scarce. S o s z k a (1975), among others, has found that in lake Śniardwy the density of fauna decreases in relation to fresh plant weight with the increasing depth. In lakes examined the influence of the depth on animals was mainly visible in their species composition and dominance structure, being especially distinct in Lake Głębokie. According to K o n s t a n t i n o v (1970) the influence of depth on river epifauna is connected with the possibility of light penetration, which conditions the growth of phytoperiphyton – one of its main sources of food. It seems, that depending on depth the qualitative differentiation of fauna living on plants in lakes examined can be explained by different water transparency – low in Lake Głębokie and high in Lake Piaseczno. The influence of light on fauna distribution may be also connected with different phototactic sensitivity of its representatives (Z a b o l o c k i j 1939, G r o m o v 1962). Also oxygen conditions could have a significant influence on the distribution of fauna. They were worse in Lake Głębokie and deteriorated with the increasing depth, accompanied by impoverishing species composition of animals in this lake.

Undoubtedly these factors, among many others, decide about the distribution not only of the fauna living on plants. It has been proved that benthos in lakes Piaseczno and Głębokie show similar regularities as regards occurrence (K o r n i j ó w 1988).

5. SUMMARY

The aim of this research has been an investigation of vertical and horizontal distribution of fauna colonizing *Myriophyllum alternifolium* and *Ceratophyllum demersum* in mesotrophic Lake Piaseczno, and *Ceratophyllum demersum* and *Potamogeton lucens* in eutrophic Lake Głębokie (Łęczna–Włodawa Lakeland). The studies in mesotrophic lake were conducted at the depths 0.5, 2 and 4 m in psammolittoral and marsh phytolittoral, whereas in the eutrophic lake – at the depths 0.5 and 2 m in marsh and atrophic phytolittoral. The littoral division into types was made after B e r n a t o w i c z and Z a c h w i e j a (1966).

Differences between fauna colonizing different littoral types in the mesotrophic lake concerned mainly its species composition (Table 1) and dominance structure (Fig. 1), whereas in the eutrophic lake – its density and biomass, especially in relation to bottom surface (Figs. 2, 3). No significant similarities were observed between the fauna colonizing atrophic phytolittorals in both lakes.

Vertical differentiation of fauna living on plants was very distinct in the eutrophic lake and concerned mainly the invertebrate species abundance, which decreased there with the increasing depth (Table 1). The influence of depth has been also observed, although to a smaller extent, in the dominance structure of fauna in both lakes (Fig. 1).

While analysing the causes of these regularities for the fauna distribution in lakes examined, factors depending on the trophy of lakes, i.e., transparency, water oxygenation and food conditions, have been discussed.

6. POLISH SUMMARY

Celem pracy było zbadanie pionowego i poziomego rozmieszczenia fauny zasiedlającej *Myriophyllum alternifolium* i *Ceratophyllum demersum* w mezotroficznym jez. Piaseczno oraz *Ceratophyllum demersum* i *Potamogeton lucens* w eutroficznym Jez. Głębokim (Pojezierze Łęczyńsko-Włodawskie). W jeziorze mezotroficznym badania prowadzono na głębokości 0,5, 2 i 4 m w psammolitoralu i fitolitoralu bagiennym, a w jeziorze eutroficznym na głębokości 0,5 i 2 m w fitolitoralu bagiennym i zanikającym. Podział litoralu na typy przyjęto wg B e r n a t o w i c z a i Z a c h w i e i (1966).

Różnice między fauną zasiedlającą odmienne typy litoralu w jeziorze mezotroficznym dotyczyły głównie jej składu gatunkowego (tab. 1) i struktury dominacji (rys. 1), natomiast w jeziorze eutroficznym – jej liczebności i biomasy, zwłaszcza w odniesieniu do powierzchni dna (rys. 2, 3). Nie stwierdzono istotnych podobieństw między fauną zasiedlającą fitolitorale zanikające w obydwu jeziorach.

Zróżnicowanie pionowe fauny naroślinnej było szczególnie wyraźne w jeziorze eutroficznym i dotyczyło głównie bogactwa gatunkowego bezkręgowców, które malało w nim wraz ze wzrostem głębokości (tab. 1). Wpływ głębokości zaznaczył się także, chociaż w mniejszym stopniu, w odniesieniu do struktury dominacji fauny obydwu jezior (rys. 1).

Analizując przyczyny stwierdzonych prawidłowości w rozmieszczeniu fauny w badanych jeziorach, poddano m.in. dyskusji oddziaływanie czynników zależnych od trofii zbiorników, takich jak przezroczystość, natlenienie wody oraz warunki pokarmowe.

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