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ZONALITY IN OCCURRING OF ZOOPLEUSTON IN TWO EUTROPHIC LAKES ON ŁĘCZNA-WŁODAWA LAKELAND

Wojciech Płaska

Department of Hydrobiology, University of Life Sciences in Lublin
Dobrzańskiego str. 37, 20-262 Lublin, wojciech.plaska@up.lublin.pl

Summary. The aim of conducted research was to describe the zonality in occurring of zoopleston in shallow eutrophic lakes. Zoopleuston structure discovered in examinate reservoirs was quite different than in depression reservoirs on Łęczna-Włodawa Lakeland. It was related to reach plant of shallow litoral zone. In qualitative and quantitative structure more reaches was fund in water/land contact zone what is common to rather research conducted in those zones. Fundamental differences are in dominants composition as in water/land contact zone dominated mainly Coleoptera but on the depth of 0.5 m Collembola share was significantly higher than in others reservoirs. The reason of such situation was probably macrophytes creating so called „islands" used by epipleustonic Collembola.

Key words: zoopleuston, zonality, eutrophic lake, water/land zone, shallow littoral

INTRODUCTION

In lake littoral the factor that influence on biocenosis structure shape may be depth and shape of lake basin. It affects littoral reach and scale as well as diversity of water plants forming refugees for macrofauna complexes typical for littoral and small water reservoirs. Specially favorable habitats arise in shallow eutrophic lakes where water waving and wind are not factors limitation plants growth. Animals group especially sensitive to those factors is zoopleuston**.** This work is continuation of research on zonality in occurring of zoopleuston in lakes and anthropogenic reservoirs littoral of Łęczna-Włodawa Lakeland. So far visible adherence of specific taksons to specific zones was indicated and interrelation of numbers and species richness according to specific habitats in mezotrophic lakes and depression reservoirs [Płaska 2002, 2007]. The aim of this study

is to analyze above issue in eutrophic lakes shallow littoral that is the most typical for zoopleuston.

STUDY AREA, MATERIAL AND METHODS

Researches were conducted on two eutrophic lakes: Głębokie Uścimowskie and Miejskie on Łęczna-Włodawa Lakeland (south-east of Poland). Research were conducted from April to November in 2007. Samples were taken monthly in three iterations from two shallow littoral zones: water/land contact zone and on the depth of 0.5 m. The area of sample 0.25 m^2. The samples were taken using metal frame and hand net.

The area of Uścimowskie Głębokie Lake is 21 ha and maximal depth is 7.1 m (N: 51° 28' 33'', E: 22° 55'21"). It is strongly eutrophic reservoir sometimes rated among hypertrophic lakes [Radwan and Kornijów 1998]. In recent years its condition was improved thanks to sewage management regulation in nearby village. This is the reason why submerge macrophytes strongly expanded. In examined water/land contact zone occurred: *Hydroharis morsus-ranae*, *Lemna minor*, *Alisma plantago-aquatica* and *Eleocharis palustris*. On the depth of 0.5 m dominated: *Phragmites australis* and *Myriophyllum spicatum*.

The area Miejskie Lake is 45.4 ha and maximal depth is 2.2 m (N: 51° 30' 18'', E: 22° 52'50"). Rich emerged plants occurre here [Radwan and Kornijów 1998]. In examined contact zone dominated: *Hydrocharis morsus-ranae*, *Lemna minor* and *Carex sp*. On the depth of 0.5 m dominated: *Phragmites australis* and *Potamogeton crispus*.

RESULTS

Quantitative structure

In both zones taksons number was nearly the same. In Głębokie-Uścimowskie Lake the largest taksons number in water/land contact zone was found in July and September (7). The least taksons in water/land contact zone were in October (3) Slightly less number of species occurred on the depth of 0.5 m in June (5). The less number of taxons was found on the depth of 0.5 m in May and November (1) (Fig. 1).

In Miejskie Lake the largest number of taksons in water/land contact zone was in August (8), but on the depth of 0.5 m it occurred in June (7). The less number of species in both zones occurred in autumn and it amounted from 1 to 4 taksons. The only exception was June when in water/land contact zone minimum was also (2) (Fig. 2).

Qualitative structure

In Głębokie-Uścimowskie Lake in contact zone had the highest density of zoopluston 132 ind. m^{-2} in July. The largest taxonomic group in water/land zone were beetles, their mean density was 29 ind. m^{-2} (Tab. 1), but their maximal density in July was 110 ind. m^{-2}. On the depth of 0.5 m maximum density of zoopleuston was observed in August and it was 24 ind. m^{-2}, with the only taxon in this zone were then water bugs. Both Collembola and Diptera there were very low sample sizes in both areas. These values ranged from 0 to 3 ind. m^{-2} (Fig. 3).

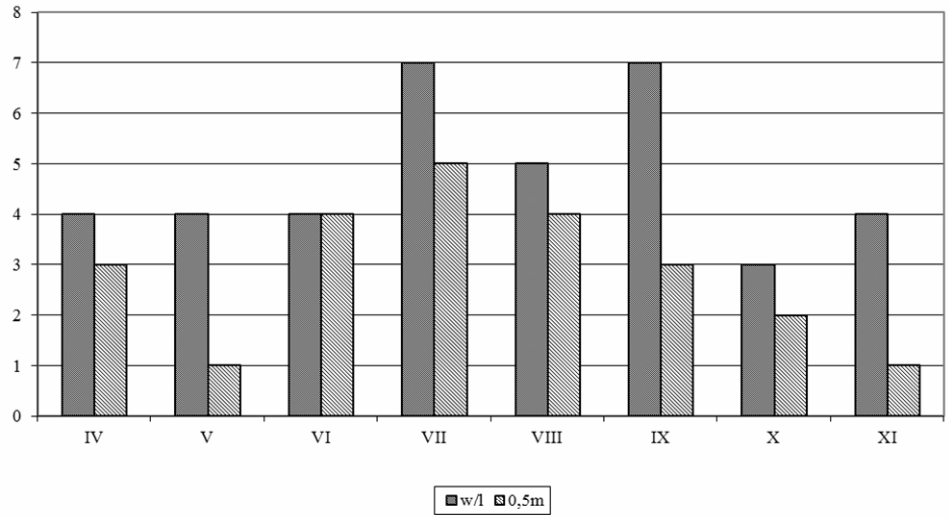

Fig. 1. Number of zoopleuston taxa in investigated zones Głębokie Uścimowskie Lake

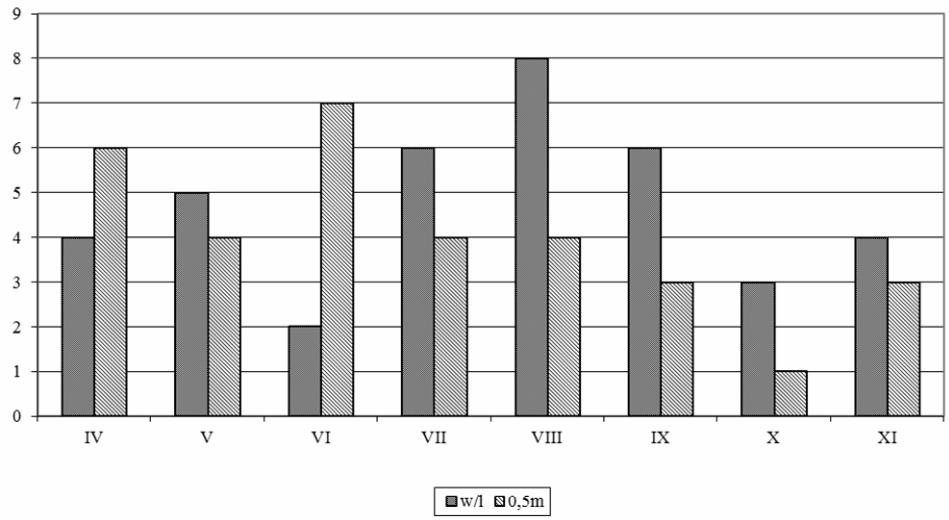

Fig. 2. Number of zoopleuston taxa in investigated zones Miejskie Lake

In Miejskie Lake zoopleuston occurred in highest concentrations in the contact zone of the water/land in July, reaching a density of 178 ind. m^{-2}. The largest taxonomic group was Collembola occurring in the density of more than

Table 1. Density of zoopleuston in investigated lakes (mean values for studied period)

No.	Taxon	Głębokie Uścimowskie Lake n = 24		Miejskie Lake n = 24	
		w/l ind. m^{-2}	0.5 m ind. m^{-2}	w/l ind. m^{-2}	0.5 m ind. m^{-2}
1.	*Cymatia coleoptrata* (Fabr.)	0.2	0.2	0.2	
2.	*Callicorixa praeusta* (Fieb.)				0.5
3.	*Sigara falleni* (Fieb.)		0.2		0.2
4.	*Sigara striata* (L.)				0.3
5.	*Notonecta glauca* L.	1.4	0.6	1.3	0.2
6.	*Plea minutissima* Leach	0.3		0.9	0.2
7.	*Iliocoris cimicoides* (L.)	3.8		3.5	0.3
8.	*Nepa cinerea* L.	0.3		1.6	
9.	*Ranatra linearis* (L.)				0.2
10.	*Microvelia reticulata* (Burm.)	0.5	0.5	0.2	
11.	*Gerris argentatus* Schumm.	1.1		1.6	0.3
12.	*Gerris lacustris* (L.)	0.3		0.4	
13.	*Gerris lateralis* Schumm.	0.3			
14.	*Gerris odontogaster* (Zett.)	0.8	0.5		
15.	*Corixinae* larvae indet.	0.2		0.6	1.3
16.	*Gerridae* larvae indet.	2.2	1.1	0.7	
17.	*Coleoptera* indet.	29.0	2.0	34.6	2.4
18.	*Diptera* indet.		0.2		
19.	*Isotomurus palustris* (Müll.)	0.6	0.7	0.7	2
20.	*Podura aquatica* L.	0.6	0.8	12.6	24.1

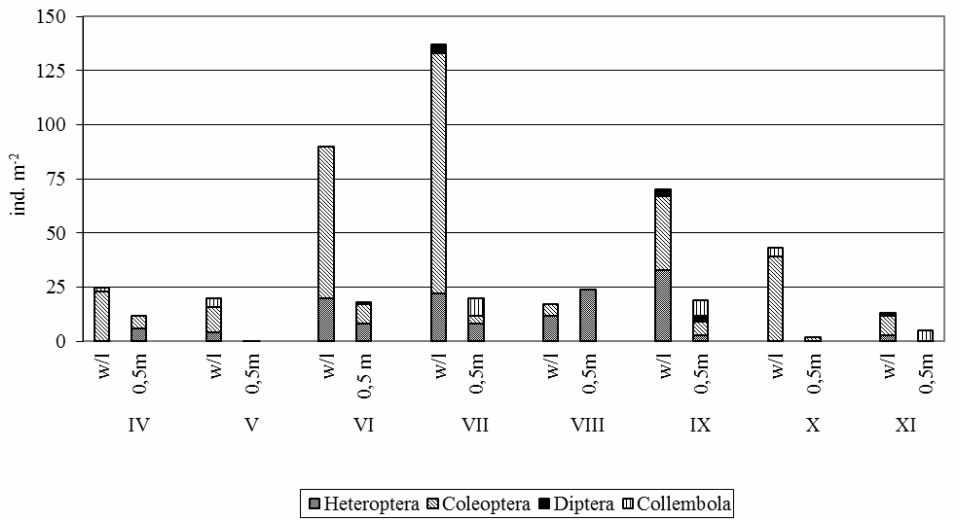

Fig. 3. Density of zoopleuston in investigated zones Głębokie Uścimowskie Lake

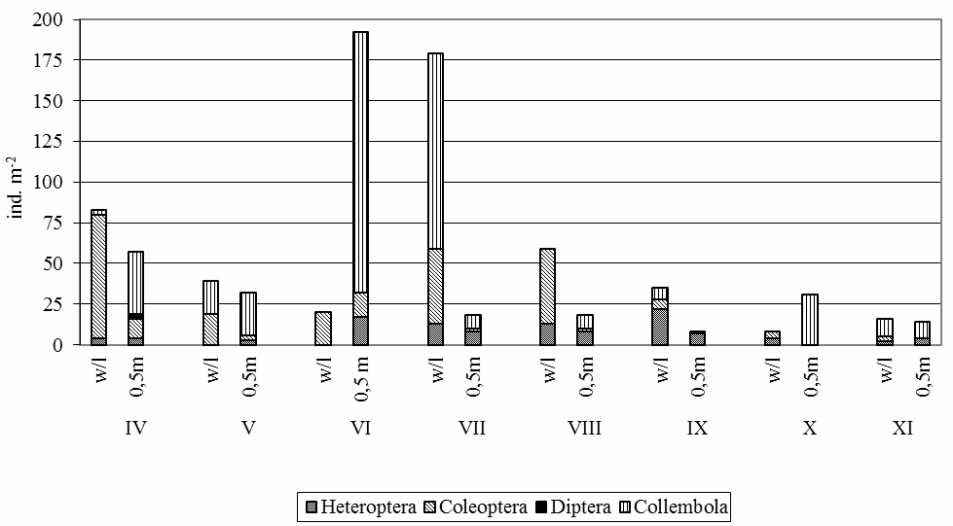

Fig. 4. Density of zoopleuston in investigated zones Miejskie Lake

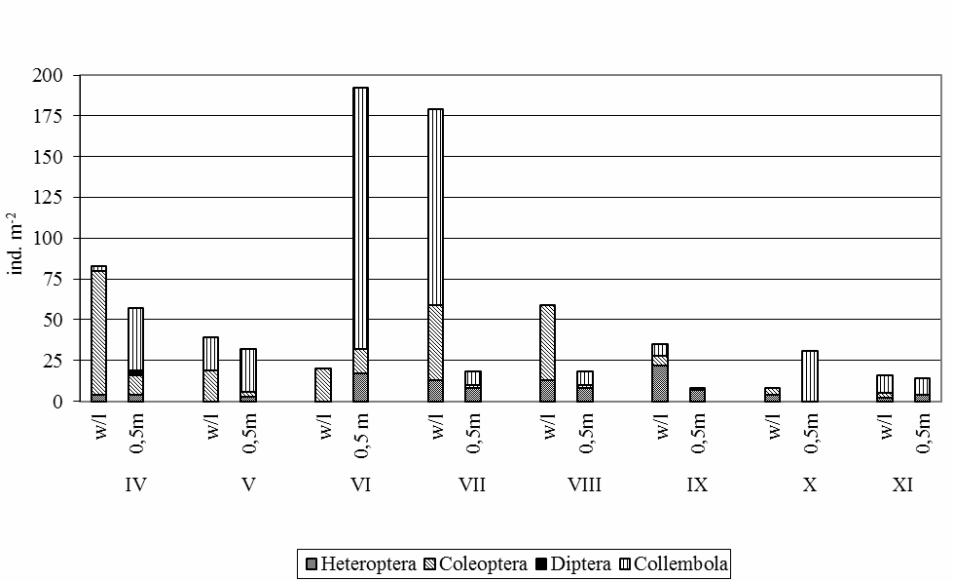

Fig. 5. Percentage avarande dominated zoopleuston taxons in investigated zones Głębokie Uścimowskie and Miejskie Lake

125 ind. m^{-2}. At a depth of 0.5 m in June zoopleuston density was slightly higher occured192 ind. m^{-2}, and the most frequently occurring taxon were also reaching the number of springtails in density over 160 ind. m^{-2} (Fig. 4).

Domination

In Uścimowskie Lake in contact zone dominated taxon was Coleoptera – 71%. Among Heteroptera *Ilyocoris cimicoides* predominated – 9%, slightly less were *Gerridae* larv. – 5%. The rest of taxons amounted 16% of total zoopleuston number. Also on the depth of 0.5 m Coleoptera (31%) dominated above the other taxons. Second taxons group from quantity point of view appeared *Gerridae* larv. – 17%. *Podura aquatica* occured 12%, *Isotomurus palustris* 10%, and *Notonecta glauca* 8%. The share of other taxons was 23% (Fig. 5).

In Miejskie Lake in water/land contact zone beetles dominated – 59%. In that reservoir significant domination of *Podura aquatica* appeared 22%. Among Heteroptera *Ilyocoris cimicoides* amounted 6% and *Nepa cinerea* 3%. The rest of taxons amounted together 10%. On the depth of 0.5 m dominating species were: *Podura aquatica* 75%. Coleoptera 7%, and *Isotomurus palustris* amounted level of 6%. The others taxons amounted 12% of total zoopleuston number (Fig. 5).

DISCUSSION

In zonality of zoopleuston occurring in examined lakes higher number of taxons was noted almost always in water/land contact zone. Large species richness of contact zone may be caused by so called „contact effect". It appears as growth of species variety [Naiman and Decamps 1997]. Another but also important reason could be very complex spatiality structure in contact zone making specific refugees. It provided one efficient shelter against predators as well as allowed for easy access to food for either predators or herbivore detritusfiding invertebraters [Biesiadka and Moroz 1996, Kurzątkowska 1999, Tolonen *et al.* 2001, 2003]. Other researches confirm that water invertebrates populated water plants clusters – specific refugees, looking for shelter against predators there [Mittelbach 1988, Paterson 1993]. In Pilica oxbow lakes pleuston fauna significant tendency to marginal zone sprouted by plants and lack of it in areas far from coast and plants [Tończyk 2004]. Whereas in devoiced of fish Danish Lake Lilla *Corixidae* occurrence was noted even on the depth 9 m [Oscarson 1987].

In zoopleuston of each biotic zone the largest number increase appeared in water/land contact zone among Coleoptera and Heteroptera. However quantity structure depended in greatly on littoral diversity and dominating taxons group populating given reservoir. Higher number in water/land contact zone were connected with numerous occurring of species characteristic for ecoton zones and described as so called „contact effect" [Naiman and Decamps 1997]. In Miejskie Lake that dependences were formed poorly because of not typical, inversed composition of Collembola composition. It was caused by rich rushes plants growth on the depth of 0,5 m what makes efficient barrier against waving and wind for Collembola. Predatory fish pressure is not important in case of that taxonomic group, because they are not attractive food for fish.

Each zoopleuston taxa domination was connected with littoral diversity in delaminated lakes. That is why significant differences may be mainly caused by littoral plants growth level so called: habitant architecture. In shallow littoral of examined lakes clear domination of Coleoptera and *Podura aquatica* was found. High number of Collembola occurred often in land/water zone and shallow water zone and their process is described as fluctuation and difficult to explain. They appear usually for a short term dominating above other zoopleuston taxons [Stach 1955]. In examined lakes in water/land contact zone mainly *Coleoptera* occurred. This is different normality than found in researches on other lakes and depression reservoirs on Polesie [Płaska 2002, 2007]. It is probably the result of abundant water plants growth what imitates waving at the same time differentiating habitats of small eutrophic lakes shallow littoral. Predatory *Coleoptera* domination in water/land contact zone and temporary high number of detritusfigind collembola on bigger depth in Miejskie Lake leaded also to creation a different trophic groups configuration that proved in earlier researches [Płaska 2002, 2007].

CONCLUSION

Zone deployment of zoopleuston in shallow eutrophic lakes characterized a high abundance and high species richness in land/water zone, but may be slightly different than in depression reservoirs and mezotrophic lakes. It can be caused by complex shallow littoral spatiality structure made by submerge and rushes plants and also bigger than in large water reservoirs exposition on waving. In favorable conditions epipleuston taxons typical for contact zone may concentrate on bigger depth treating macrophytes „islands" as piece of land.

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STREFOWOŚĆ WYSTĘPOWANIA ZOOPLEUSTONU W DWÓCH EUTROFICZNYCH JEZIORACH NA POJEZIERZU ŁĘCZYŃSKO-WŁODAWSKIM

Streszczenie. Celem przeprowadzonych badań było określenie strefowości występowania zoopleustonu w dwóch płytkich jeziorach eutroficznych. Stwierdzona w badanych zbiornikach struktura zoopleustonu była nieco inna niż w zbiornikach zapadliskowych na Pojezierzu Łęczyńsko-Włodawskim. Związana była ona z bogatą roślinnością strefy płytkiego litoralu. W strukturze jakościowej i ilościowej większe bogactwo stwierdzano zazwyczaj w strefie stykowej woda/ląd, co jest zbieżne z innymi badaniami prowadzonymi w tych strefach. Zasadnicze różnice występują w składzie dominantów, gdyż w strefie stykowej woda/ląd dominowały głównie Coleoptera, a na głębokości 0,5 m udział Collembola był zdecydowanie wyższy, niż w zbiornikach zapadliskowych. Przyczyną takiego składu dominantów były prawdopodobnie makrofity tworzące „wyspy" wykorzystywane przez epipleustonowe Collembola.

Słowa kluczowe: zoopleuston, strefowość, jeziora eutroficzne, strefa woda/ląd, płytki litoral