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COMPARATIVE STUDY OF EPIPHYTIC AND BENTHIC FAUNA OF SHALLOW EUTROPHIC LAKE OF POLESKI NATIONAL PARK[1]

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Summary. Species structure, abundance and distribution of epiphytic and benthic invertebrates associated with stands of *Myriophyllum spicatum* L. were studied in shallow eutrophic Lake Długie in Poleski National Park. Macrofauna was collected in three seasons (May, July and October) of 2001. The zoocenoses differ in terms of seasonal dynamics of their density, taxa composition and domination structure. The abundances of studied groups were affected by the season. Epiphytic fauna showed significantly higher densities than benthic invertebrates, reaching the highest abundances in summer and the lowest in spring. Density of zoobenthos increased from spring to autumn. Phytophilous fauna, depending on season, was dominated by Naididae, Trichoptera and Chironomidae larvae. Zoobenthos in all seasons represented pelophilous chironomids.

Key words: epiphytic fauna, zoobenthos, submerged vegetation, shallow lake

INTRODUCTION

The abundance of littoral macroinvertebrates is closely related to the presence of soft vegetation. Submerged macrophytes change the physical and chemical conditions of their surroundings, provide food (periphytic algae) for a majority of invertebrates and refuge from predators, and thus create habitats for both phytophilous and bottom fauna [Carpenter and Lodge 1986, Vermaat *et al*. 2000, Madsen *et al*. 2001, Cheruvelil *et al.* 2002, Pinowska 2002, Tessier *et al*. 2004]. Usually epiphytic and benthic organisms are considered as one ecological group, mostly due to their similar composition at order and family levels [Glinsky 1984,

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Hershey 1985, van den Berg *et al.* 1999]. Only a few studies comparing both zoocenoses stressed their differences in species composition, seasonal abundance as well their role in lake ecosystems [Kajak 1988, Kornijów and Kairesalo 1994, Tarkowska-Kukuryk and Kornijów 2008]. Most of benthic taxa are associated with one specific substrate, sand, mud or stone habitats [Kajak 1988, Chaloner and Wotton 1996]. Many phytophilous taxa are absent in bottom sediments. Seasonal migration from plants surface to the bottom sediments is usually observed in autumn during decreasing of vegetation [Kornijów 1992].

The study aims at evaluation of the distribution and abundance of macroinvertebrates between plant surface and bottom sediments inside homogenous beds of Eurasian watermilfoil (*Myriophyllum spicatum* L.).

STUDY AREA, MATERIAL AND METHODS

The studies were conducted in the shallow eutrophic Lake Długie (surface area 31.5 ha, max. depth 1.8 m) situated in the area of the Poleski National Park (Tab. 1). The zone of submerged vegetation was dominated by *Myriophyllum spicatum* L. (constituting 96% of macrophyte cover) with four accompanying taxa: *Elodea canadensis* Rich., S*tratiotes aloides* L., *Potamogeton acutifolius* Link and *Potamogeton lucens* L. Samples of epiphytic and benthic invertebrates were collected in May, July and October 2001 from three sites inside homogenous beds of *Myriophyllum spicatum* L.

Table 1. Physical and chemical characteristic of Lake Długie (mean values for summer period)

Secchi disc visibility, m	pH	Conductivity, $\mu S\ cm^{-1}$	Dissolved oxygen, $mg\ L^{-1}$	TP, $\mu g\ L^{-1}$	TN, $mg\ L^{-1}$	Total suspension, $mg\ L^{-1}$	Chlorophyll *a*, $\mu g\ L^{-1}$	TSI
1.1*	8.4	229	10.2	56.3	11.6	18.5	12.3	58.5

* to the bottom

Phytophilous fauna was collected by means of a cylindrical apparatus, with openings covered by net of 250 µm mesh size [Kornijów 1998]. The plants were at first sampled by floristic anchor and then transferred into the apparatus, put into a plastic bag and transported to the laboratory. The biomass of submerged vegetation was estimated on each occasion using Bernatowicz rake [Bernatowicz 1960] at 10 randomly chosen places.

The samples of benthic midges (10 cores of the bottom sediments per 1 sample) were taken from 3 sites, using a tube apparatus (surface area 15.2 cm^2). The sediments collected were sieved through the 250 µm mesh size net, put into plastic bags and transported to the laboratory.

At the laboratory, chironomids larvae were selected from macrophytes and sediments samples, divided into epiphytic and benthic taxa, and preserved in 4% formaldehyde solution. Collected invertebrates were counted and identified under dissected microscope; the nomenclature of taxa was accepted after Wiederholm [1983] and Kołodziejczyk and Koperski [2000]. Densities were calculated per m^2 of bottom surface.

All data collected were analysed statistically by means of GLM and CORR procedures of SAS Programme [2001]. The test of Kołmogorow-Smirnow was used to verify the normal distribution of collected data. The significance of differences between mean densities of epiphytic and benthic fauna, as well as of the influence of season on their densities, were verified using one-way analysis of variance (ANOVA).

RESULTS

Total number of taxa of studied zoocenoses showed similar values and amounted to 23 (epiphytic fauna) and 26 taxa (bottom fauna) (Tab. 2). Differences were observed in studied seasons. The number of epiphytic taxa ranged from 11 (October) to 14 (July), bottom taxa from 7 (May) up to 18 taxa (October) (Tab. 2).

Table 2. Species composition of epiphytic and benthic fauna at *Myriophyllum spicatum* stands in Lake Długie in studied seasons

Taxon	Epiphytic fauna			Benthic fauna		
	May	July	October	May	July	October
Naididae	+*	+		+		
Styllaria lacustris L.	+*	+*	+			
Tubificidae					+	+
Hirudinea		+				+
Hydrachnidia		+			+	+
Ephemeroptera		+	+*			+
Anisoptera	+					
Zygoptera larvae	+		+	+		+
Corixidae					+	+
Dixidae					+	
Chironomidae larvae						
Ablabesmyia phatta (Eggert)		+		+		
Procladius sp.		+		+**	+	+**
Cricotopus sp.			+			
Cricotopus sp. (gr. *sylvestris*)	+					
Psectrocladius sp. (gr. *sordidellus*)	+**					+
Cryptochironomus sp.					+	
Cladopelma sp. (gr. *lateralis*)				+		+
Einfeldia sp.					+**	
Endochironomus albipennis (Meigen)	+	+	+			
Endochironomus impar (Walker)				+		
Dicrotendipes sp.		+	+**			

Glyptotendipes sp.						
Microtendipes sp. (gr. *pedellus)*						+
Polypedilum sp.					+	
Polypedilum sp. (gr. *convictum)*		+				+
Polypedilum sp. (gr. *nubeculosum)*						+
Polypedilum sordens (v.d. Wulp)	+	+				
Phaenopsectra flavipes (Meigen)						+**
Tanytarsus sp.					+	+
*Paratanytarsus austriacus*Kieffer	+	+				
Chironomidae Pupae	+					
Chironomidae n. det					+	
Ceratopogonidae			+			
Trichoptera larvae						
Polycentropodidae	+	+*	+*	+	+	+
Orthotrichia sp.			+			+
Lepidoptera					+	+
Gastropoda						
Lymnaea peregra (O.F.Müller)			+			
Planorbis planorbis L.	+	+	+			
Valvata piscinalis (O.F.Müller)						+
Number of taxa per season	12	14	11	7	12	18
Total number of taxa	23			26		

* dominating taxon; **dominating taxon of Chironomidae

The domination structure of epiphytic fauna depended on the season (Fig. 1). In May the highest percentage was found for Naididae (61% of total density), in July – Naididae (44%) and Trichoptera larvae (35%) (Fig. 1). In October, epiphytic fauna was represented mostly by larvae of Chironomidae, reaching 53% of total density. Bottom fauna in all studied months was dominated by chironomids, the larvae accounting for from 60% (July) up to 71% (October) of the total density of zoobenthos (Fig. 1).

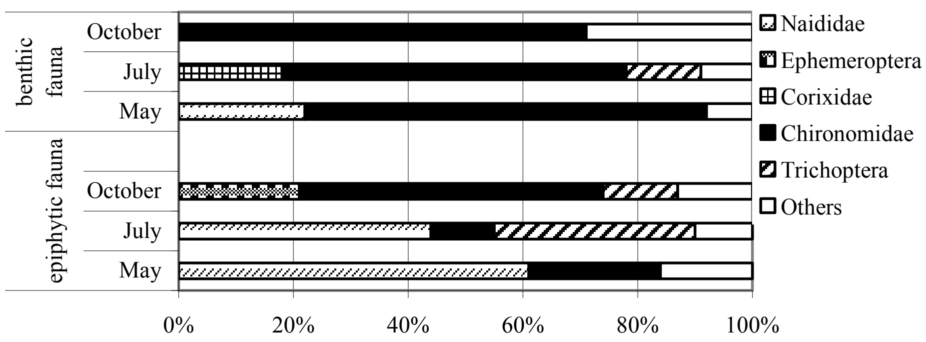

Fig. 1. Relative abundances of epiphytic and bottom fauna in Lake Długie in 2001

The structure of Chironomidae larvae on *Myriophyllum spicatum* changed depending on the season (Fig. 2). In May the most abundant were larvae of phytophilous *Psectrocladius* sp. (gr. *sordidellus*), in July – eurytopic *Dicrotendipes* sp. and phytophilous *Ablabesmyia phatta*, and in October – *Dicrotendipes* sp. (Tab. 2).

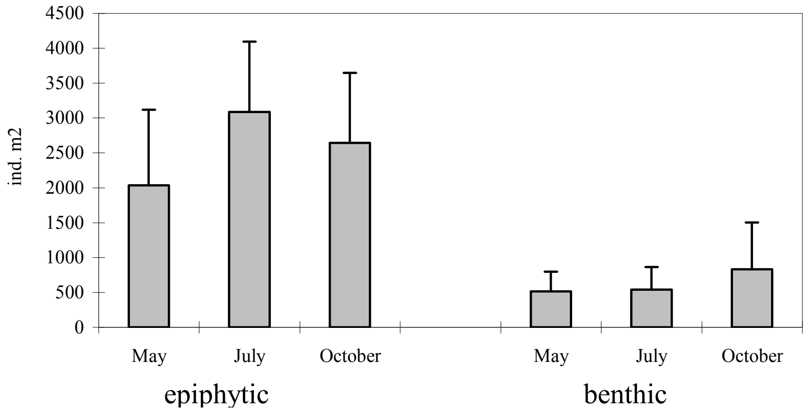

Fig. 2. Average densities (±SD) of epiphytic and benthic fauna on *M. spicatum* stands in Lake Długie in studied months

The structure of midges larvae in bottom sediments showed domination of pelophilous taxa in all studied months (Fig. 2). Larvae of *Procladius* sp. were the most abundant in May and October, *Phaenopsectra flavipes* in October and *Einfeldia* sp. in July.

Through the whole studied period epiphytic fauna showed significantly higher densities than benthic invertebrates (ANOVA, $F = 49.01$; $p < 0.001$) (Fig. 2). Densities of phytophilous (ANOVA, $F = 17.95$; $p = 0,005$) and benthic (ANOVA, $F = 33.94$; $p < 0.001$) fauna were affected by the season. Observed densities of epiphytic fauna ranged from 2035 ind. m^2 in May to 3069 ind. m^2 in July. Numbers of benthic fauna increased from May to October and amounted to from 517 to 833 ind. m^2.

DISCUSSION

The comparative study of epiphytic and benthic fauna associated with *Myriophyllum spicatum* stands confirmed visible differences of both zoocenoses. As it was stated by Kajak [1988] and Kornijów *et al*. [1990], the zoocenoses differ in terms of seasonal dynamics of their density, taxa composition and domination structure, and thus should not be considered as one ecological group.

High abundances and species richness of epiphytic fauna observed in the studied lake are closely related to habitat conditions. The role of *M. spicatum,* a macrophyte species with finely dissected leaves, was emphasised previously as substratum for macrofauna by studies of Cyr and Downing [1988a, b], Chilton [1990] and Pieczyńska *et al*. [1999]. Epiphytic fauna was represented mainly by phytophilous taxa. In spring and summer there dominated Naididae which are usually associated with habitats with dense vegetation, living on macrophytes or mats of filamentous algae [Armendariz 2000]. The population of epiphytic midges consisted mostly of larvae of *Psectrocladius* sp. (gr. *sordidellus*), usually associated with soft vegetation, as well as *Dicrotendipes* sp. and *Endochironomus impar* which are typical for detritus-rich macrophyte habitats [Moller-Pillot and Buskens 1990, Berg 1995]. High densities of epiphytic taxa should be considered as being a result of abundant and available food. The leaves of *M. spicatum*, similarly to other macrophyte species, are densely colonised by periphyton. Epiphytic algae, mostly diatoms, constitute an important diet component of naidids like *Styllaria lacustris* L. and many chironomids taxa [Streit 1978, Dvorak 1996].

Bottom invertebrates showed visibly lower abundances than epiphytic. It can be a consequence of oxygen conditions. In the studied lake *M. spicatum* created dense homogenous beds. It might be expected that under dense cover of vegetation, very low concentrations of dissolved oxygen might create inhospitable conditions for benthic animals. As it was reported by Frodge *et al*. [1990] and Blindow [1992], water flow near the sediments is facilitated under patchy vegetation cover, creating good oxygen conditions for zoobenthos. The presence of unvegetated areas enables light penetration, which stimulates benthic algae to growth. Studies of Liboriussen *et al*. [2005] found that light may affect the biomass of benthic grazers and the density of benthic chironomids can be positively correlated with benthic algae biomass. In the present study zoobentos was represented mostly by pelophilous chironomids larvae of *Procladius* sp., *Phaenopsectra flavipes* and *Einfeldia* sp. These are typical detritivorous taxa characteristic of organically rich sediments under macrophytes [Armitage *et al.* 1995, James *et al*. 2000].

Peaks of density of studied zoocenosis were related to the vegetation cycle in the lake ecosystem. Phytophilous fauna reached the highest abundance in July. In summer, due to intensive growth of plant biomass, the colonisation surface area increases („dilution effect"), which enhances the rapid development of epiphytic organisms [Kornijów and Ścibior 1999]. Bottom fauna was the most numerous in October. In autumn the highest biomass of organic material is usually observed in sediments, which is reflected in rapid development of detritivorous taxa [Kajak 1988, Bogut *et al*. 2007].

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STUDIUM PORÓWNAWCZE FAUNY NAROŚLINNEJ I DENNEJ PŁYTKIEGO EUTROFICZNEGO JEZIORA W POLESKIM PARKU NARODOWYM

Streszczenie. Celem badań była analiza struktury gatunkowej, zagęszczenia i rozmieszczenia fauny naroślinnej i dennej zasiedlającej stanowiska porośnięte przez *Myriophyllum spicatum* L. w płytkim, eutroficznym jeziorze Długie w Poleskim Parku Narodowym. Próby makrofauny pobierano w trzech sezonach (maj, lipiec, październik) w 2001 r. Badane zoocenozy różniły się pod względem składu taksonomicznego i struktury dominacji, jak również wykazywały wyraźne sezonowe zmiany zagęszczenia. Stwierdzono widoczny wpływ sezonu na liczebności badanych grup. Fauna naroślinna wykazywała istotnie większe zagęszczenia niż fauna denna, osiągając największe wartości latem, zaś najmniejsze wiosną. Zagęszczenie fauny dennej wzrastało od wiosny do jesieni.

Słowa kluczowe: fauna naroślinna, zoobentos, makrofity zanurzone, płytkie jezioro