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PEAT-BOG POOL (WIELKOPOLSKI NATIONAL PARK) AS A HABITAT OF SPECIFIC COMMUNITIES OF ZOOPLANKTON*

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A b s t r a c t. The study on the structure of the rotifer and crustacean communities of a polihumic dystrophic water body was made with respect to specific physical-chemical and biological parameters connected with the lack of fish predation. Within the whole examination period only invertebrate predation was observed with a high participation of *Chaoborus* larvae, which probably structured the plankton assemblages. There were 88 zooplankton species identified, with rotifers dominating. The summer months were taxonomically the richest, while winter was the poorest. With regard to the zooplankton densities the dominance of rotifers over crustaceans was recorded. The highest numbers of individuals were noticed in the spring-summer season, while the lowest in the winter. A high participation of 'pond' and acidophilic forms was found.

K e y w o r d s: *Chaoborus* predation, polihumic dystrophic water body, zooplankton

INTRODUCTION

Small water bodies are usually natural and shallow and are characterised by a lack of temperature differentiation between the surface and bottom parts of the water. Aquatic vegetation creates here a mosaic of habitats [23]. Ponds differ in relation to their origin, trophic conditions, surface area or depth. Many environmental conditions, e.g. the concentration of nutrients, phosphorus and nitrogen, the concentration of dissolved mineral salts, pH or water transparency, may vary between particular water bodies, influencing the functioning of plant and animal biocoenoses [11,18]. The examined reservoir is specific as the greatest part of its basin is covered by centrally situated *Sphagnum* peat inland.

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The aim of the study was to determine the structure and dynamics of the zooplankton communities inhabiting a polihumic dystrophic water body that was characterised by specific physical-chemical and biological parameters connected with the lack of fish.

MATERIAL AND METHODS

The water filling the reservoir basin covers an area of 0.5 ha. The max depth reaches 1.8 and mean depth is 0.8 m. Due to the acid reaction of water – pH<6.4 and low calcium concentration (max 9.2 mgCa l^{-1}) this pond has been classified as dystrophic and – due to the dark brown colour of its water (300 mgPt l^{-1}) – as polihumic [1, 10].

High concentration of dissolved humic substances influences the physical-chemical features as well the biological structure of this water body. The brown colour of the water and the *Lemna* sp. floating coats which cover the surface throughout the main part of the year restrict light penetration (shallow trophogenic zone) and impede water mixing – with the exception of the ice period when there is a rapid temperature gradient between the surface and bottom. Low light penetration and high amount of organic matter result in oxygen deficiency. The high concentrations of biogenic elements, especially of phosphorus that compensates with humic compounds and becomes unavailable for primary producers, are characteristic of this kind of pond [6,8,26].

The lack of light and small amount of available biogenes is reflected in the low densities of phytoplankton and low concentrations of chlorophyll *a*. *Cryptophyceae* and *Chrysophyceae*, algae of mixotrophic abilities, have a high participation in the total numbers of the algae community. The lack of oxygen and acid reaction of water are responsible for the lack of fish in the investigated reservoir [9].

The research on the dynamics of the physical-chemical parameters of water as well as on zooplankton communities was carried out in the period of 1999-2005.

Chemical analyses were conducted according to Standard Methods for Water Analysis [22] and to Wetzel and Likens [27].

Zooplankton samples (10L) were collected in triplicate using a plexiglass core sampler (∅ 50 mm) from the central part of the pond, and concentrated using 45 μm plankton net and fixed immediately with 4% formalin.

The Mann-Whitney U-test was used in order to determine the effect of particular season on the distribution of zooplankton communities (N=39).

RESULTS AND DISCUSSION

The distinctive feature of the water was the high concentration of humic substances. On comparing the examined pond with other 175 lakes from all over the world (including Polish dystrophic water bodies) [5,6], it was noticed that its water was characterised by having one of the highest concentrations of dissolved organic carbon, which was probably a result of overshadowing by pleuston (*Lemna* sp.) and high trees, which restricted light penetration into the deep parts of water and therefore restricted UV radiation that leads to degradation of DOC [2,16,17]. Górniak further points out the importance of overshadowing on the functioning of dystrophic reservoirs. A high concentration of humic substances that create a considerable part of DOC [25], influences specific physical-chemical features of the studied water body. The humic substances from the catchment area, especially the dissolved and most chemically active fulvic acids, cause water acidification up to 4.5-6.04.

The brown colour of the water, a result of high concentrations of humic substances, restricts light penetration, which results in the creation of sharp (unless at low depth) thermo- and oxycline, a characteristic feature of dystrophic polihumic reservoirs [3,5,13]

The zooplankton community examination, carried out between 1996 and 2005, revealed a presence of 88 species, where rotifers comprised 72% (63 species) of the taxonomical structure, cladocerans 19% (18), and copepods only 9% (8). The research conducted in 1996 revealed that out of 12 small water bodies located within the area of the Wielkopolski National Park this pond was characterised by the highest biodiversity index values [14]. Rotifers dominated taxonomically over crustaceans. Moreover, the number of species varied within samples and the richest structure was characteristic for the summer months, when the optimal conditions for plankton development occur in the water bodies, and the poorest taxonomical structure was observed in the winter months (Fig. 1). There was also a considerable participation of taxa characteristic of small water bodies, e.g. *Keratella quadrata* f. *dispersa* (Carlin), *K. testudo* (Ehrenberg) or *K. ticinensis* (Callerio) and also taxa typical of acidic waters, e.g. *Lecane elsa* Hauer, *L. mira* (Murray), *Lepadella patella* f. *oblonga* (Ehrenberg), *Lepadella costata* Wulf. czy *Mytilina bisulcata* (Lucks). Additionally, in 2005, the floating peat mat was also studied. 17 species of zooplankton were identified, with the greater participation of crustaceans (7 species) in the taxonomical structure compared to the open water area. Węgleńska *et al*. [28], examining the humic Lake Flosek, also recorded habitat partition between crustaceans and rotifers.

Analysis of the zooplankton dynamics also revealed the dominance of rotifers over crustaceans, where the first group often reached 100% participation (Fig. 2).

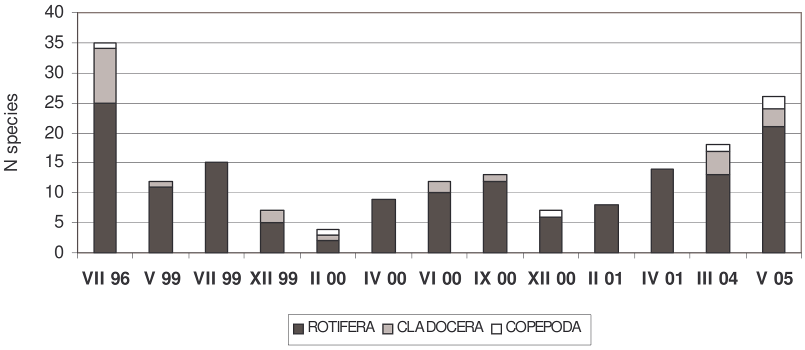

Fig. 1. The number of zooplankton species in the examined water body between 1996-2005

Only in the case of the floating peat mat did crustaceans dominate with 76% participation, in particular due to the numerous occurrence of two copepod species (*Diacyclops languidus* (Sars) and *Acanthocyclops vernalis* (Fischer)), both of which can be characteristic of this kind of habitat [4]. However, in 1996 it was found that the participation of rotifers and copepods was equal (both groups accounted for about 40%) [14,15]. The densities of zooplankton communities differed with the examination season, with the highest numbers in May 1999 and the lowest in February 2000.

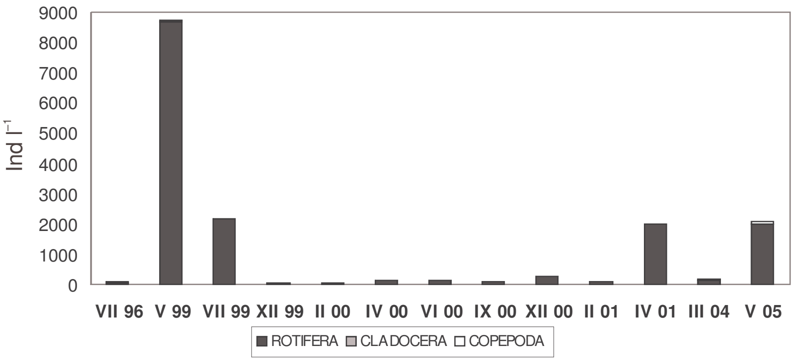

Fig. 2. Zooplankton densities in the examined water body between 1996-2005

Such an annual distribution pattern reflects the PEG model of the annual plankton succession [21], described for phyto- and zooplankton of eutrophic lakes. Analysing the seasonal dynamics of rotifer and crustacean communities it was found that the differences were not statistically significant ($p>0.05$), however, they had the highest numbers in spring, when the water surface was not overgrown by *Lemna* sp. and the oxygen conditions were favourable, contrary to the autumn-winter period when zooplankton densities were the lowest due to extremely low concentrations of oxygen (Fig. 3 a and b). An interesting phenomenon noticed in the investigated water body were the very low abundances of cladocerans, in particular the lack of large species from the genus *Daphnia*, which according to some papers dominate in the polihumic fishless lakes of northern Europe (Havens after [20]). The reason for such a reverse situation is probably due to the presence of a numerous population of the predatory larva of *Chaoborus*. Stenson and Svenson [24] state that the first instar of these larva feeds on rotifers and the next instar mainly on cladocerans. The number of *Chaoborus* larva in the examined pond varied between 0.2 and 9 ind l^{-1}, and according to Riessen [19], at concentrations over 0.5 ind l^{-1} *Chaoborus* may control large cladoceran densities.

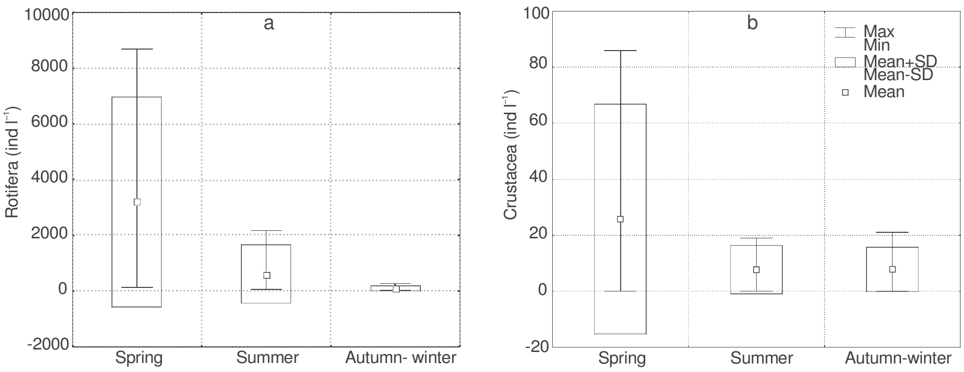

Fig. 3. Seasonal differentiation of densities of a) rotifer and b) crustacean communities of the examined water body

The group of dominants consisted of 20 species altogether (12 Rotifera and 8 Crustacea). Among them, rotifers such as *Keratella testudo, K. ticinensis, Lepadella patella* f. *oblonga* or *Synchaeta pectinata* Ehrenberg, and crustaceans such as *Chydorus sphaericus* (O F. Müller), *Pleuroxus truncatus* (O.F. Müller) and Cyclops vicinus (Uljanin) dominated in most of the sampling periods.

Furthermore, among the group of dominant species of zooplankton communities, representatives of 'pond' as well as acidophilic forms [12] were found. Additionally, among cladocerans, forms characteristic for the littoral zone of lakes or small water reservoirs were also identified (e.g. *Ceriodaphnia quadrangula* (O.F. Müller), *Chydorus sphaericus*, *Pleuroxus truncatus* and *Simocephalus vetulus* (O.F. Müller) [4].

CONCLUSION

The specific physical and chemical properties of pond water strongly affected plankton assemblages. A high participation of 'pond' and acidophilic forms was found. Lack of veretebrate predation was compensate by occurrence of great number of planktivore invertebrates (*Chaoborus* larvae). There were 88 zooplankton species identified, with rotifers dominating. The summer months were taxonomically the richest, while winter was the poorest. With regard to the zooplankton densities the dominance of rotifers over crustaceans was recorded. The highest numbers of individuals were noticed in the spring-summer season, while the lowest in the winter.

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OKRAJKOWY UKŁAD WODNO-TORFOWISKOWY ŚRÓDLEŚNEGO ZBIORNIKA (WIELKOPOLSKI PARK NARODOWY) JAKO SIEDLISKO SPECYFICZNYCH UGRUPOWAŃ ZOOPLANKTONU

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S t r e s z c z e n i e. Celem badań było określenie sezonowej struktury i dynamiki zbiorowisk polihumusowego dystroficzngo zbiornika wodnego, który charakteryzował się specyficznymi właściwościami fizyczno-chemicznymi i biologicznymi, związanymi z brakiem drapieżnictwa ze strony ryb. Podczas wieloletnich badań (1996-2005) obserwowano wyłącznie drapieżnictwo bezkręgowców, ze znacznym udziałem larw wodzienia, które to zapewne modyfikowały strukturę zespołów planktonu zwierzęcego. Ogółem wykazano obecność 88 gatunków zooplanktonu, przy czym wrotki dominowały jakościowo i ilościowo. Zarówno w strukturze taksonomicznej zooplanktonu, jak i w grupie dominantów stwierdzono duży udział gatunków o charakterze stawowym oraz acidofilnym.

S ł o w a k l u c z o w e: drapieżnictwo, *Chaoborus*, polihumusowy dystroficzny zbiornik wodny, zooplankton