

BIOCOENOTIC STRUCTURE OF TWO NEIGHBOURING WATER BODIES – A LAKE AND A POND¹

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Summary. Two water bodies, differing in size and origin, were investigated in order to compare their aquatic vegetation and zooplankton community structure.

In total, 25 macrophyte species (with *Thelypteridi-Phragmitetum* and *Typhetum angustifoliae* dominating) were found in the lake, while only 9 species (with *Ceratophylletum demersi* dominating) were recorded in the pond.

Zooplankton was examined at one station in the pond (*Ceratophyllum demersum*) and at two in the lake (open water zone and *Typha* stand). Out of 64 identified zooplankton species only 25 (39%) were common for both examined water bodies. Only one species – cladoceran *Chydorus sphaericus* – dominated in both reservoirs. Analysing the distribution of zooplankton it was observed that in the case of rotifers and copepods their mean densities were the highest in the pond, while cladocerans prevailed in the cattail zone.

Although both water bodies were very close to each other (10 m in distance) and the pond was supplied by the lake water, both aquatic vegetation and zooplankton community structure (including the taxonomical structure, zooplankton densities and dominating species) differed from each other.

Key words: rotifers, crustaceans, zooplankton, macrophytes, littoral

INTRODUCTION

Lakes, which are inland bodies of freshwater, can range in size from small reservoirs to huge bodies of water. Ponds are bodies of water which are smaller and usually shallower than lakes. They differ from lakes not only with respect to their morphological features but also in their physical-chemical features and both plant and animal community structure [Wetzel 2001, O'Sullivan and Reynolds 2004]. Globally, lakes are greatly outnumbered by ponds. However, it is

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very difficult to distinguish these two kinds of water bodies, especially if they are not very large and shallow. A pond is characterised as shallow enough for sunlight to reach its bottom, therefore permitting the growth of rooted plants at its deepest point, while a lake has no vegetation growing at its deepest point. Very often plants of a pond may grow all the way across a shallow pond basin, being of a mosaic character [Ozimek and Rybak 1994]. The littoral habitat extends in both ponds and lakes from the water edge outward as far as rooted plants grow. This area is usually the zone richest in organisms in both types of water bodies. Typically, there are three distinct ecological types of plants that make up the littoral zone: the emergent vegetation zone, floating leaved zone and submerged vegetation zone [Kłosowski and Kłosowski 2001]. In lakes these zones of vegetation start from the water edge and extend outward as far as rooted plants are able to grow, in ponds there can be a mosaic of ecological types of aquatic vegetation, mainly due to the shallowness of these reservoirs [Ozimek and Rybak 1994].

The physical-chemical parameters may be different depending on the type of water body, hence in a pond, the water temperature is usually even from top to bottom, while in lakes, the water temperature can vary with depth [Lampert and Sommer 2001].

Two closely situated water bodies, a lake and a pond, of which the smaller one is supplied by the water of the larger one, were examined in order to compare their aquatic vegetation and zooplankton community structure. A question then arises as to whether the two neighbouring water bodies, differing in size and origin, would have similar plant and animal species residing in both of those environments.

MATERIAL AND METHODS

Two water bodies, which were situated within a distance of 10 metres from each other, were examined during the early summer season of 2007. Both reservoirs differed in size and origin. Lake Mielno, of post-glacial origin, was of an area of 20 ha (mean depth = 1.8, max. depth = 3.8 m), while the artificial pond, supplied by the lake water, was of an area of 0.012 ha (depth = 0.5 m).

The lake was located mainly within a forest catchment area, however, the part adhering to the small water body was attached to a meadow. The examined lake is an open-flow water body, situated on the left flow of the river Wełna. Disturbance of the water conditions in the catchment area had probably resulted in the lowering of the water level and the overgrowing of the lake by aquatic vegetation.

Samples within the vegetated areas were taken using a plexiglass core sampler (ø 50 mm) [Schriver *et al.* 1995]. Subsamples of a volume of about 1.5 L from the surface layer (0–0.5 m) were pooled together in a calibrated vessel. The open water sample was collected using a calibrated vessel. The collected material of a total volume of 5 L was concentrated using a 45-µm plankton net and was fixed immediately with 4% formalin.

Species diversity of zooplankton inhabiting different habitats was examined using the Shannon-Weaver index [Margalef 1957].

RESULTS

There were 25 species of macrophytes, creating only 12 communities (1 of floating leaves and submerged, two of stonewort meadows and 8 of rush vegetation) identified in total in the lake (Tab.1). In the southern part of the lake only rush vegetation with *Thelypteridi-Phragmitetum* Kuiper 1957 as a dominating phytocenosis occurred. However, in the northern part of the examined lake, apart from the dominating *Typhetum angustifoliae* (Allorge 1922) Soó 1927 phytocenoses of charoids (*Charetum tomentosae* and *Nitellopsidetum obtusae*), elodeids (*Najadetum marine*) and nymphaeids (*Nupharo-Nymphaetum albae*) were also present. Species representing pleustophytes occurred only in a single specimen. In the neighbouring pond 9 species of macrophytes were recorded, out of which 8 occurred in the lake. However, their participation was different. The pond bottom was 90% overgrown by *Ceratophyllum demersum* L., while common hornwort occurred only in single specimen in the lake. 45% of the water surface of the pond was covered by *Lemna trisulca* L. and *Lemna minor* L., while in the lake the presence of only a few representatives of *L. minor* was recorded. Rush vegetation created a mosaic of small plant patches, typical for ponds, with the greatest participation of *Typha latifolia* Soó 1927.

Table 1. Dominating species (% participation of the total densities of rotifer and crustacean communities) at particular stations

Species	Pond	Lake <i>Typha</i>	Lake water
Rotifera			
<i>Collotheca mutabilis</i>		35	28
<i>Keratella cochlearis</i>		11	
<i>Keratella cochlearis f. tecta</i>		25	12
<i>Lecane closterocerca</i>	76		
<i>Lecane quadridentata</i>	12		
<i>Polyarthra remata</i>		10	32
Crustacea			
<i>Bosmina coregoni</i>		18	21
<i>Bosmina longirostris</i>		32	30
<i>Ceriodaphnia quadrangula</i>		15	
<i>Chydorus sphaericus</i>	66	12	10
<i>Acanthocyclops viridis</i>	17		
<i>Eucyclops macruioides</i>	10		
<i>Thermocyclops oithonoides</i>			16

In total 56 zooplankton species were identified in the lake and only 33 in the pond. Out of the total of 64 identified zooplankton species only 25 were common for both examined water bodies.

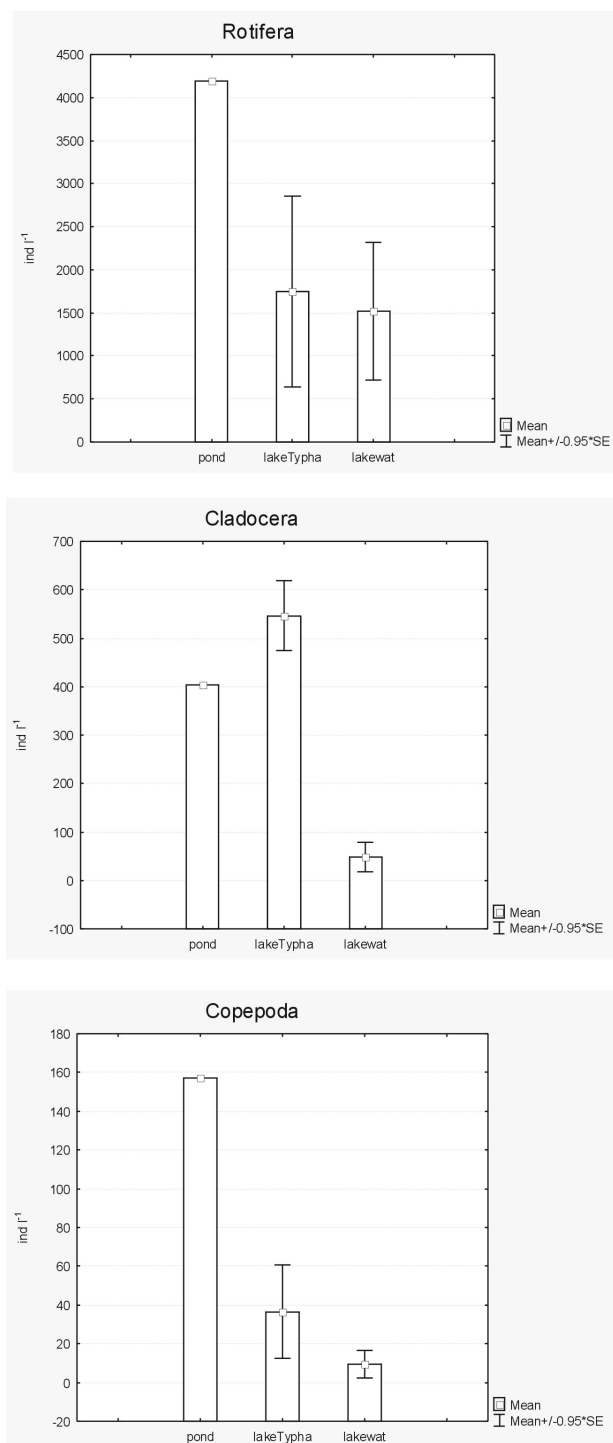


Fig. 1. Total zooplankton community densities at particular stations (lakewat – open water in the lake)

Nine zooplankton species dominated in the lake (8 in the littoral zone and 7 in the open water zone): *Collotheca mutabilis* (Hudson), *Keratella cochlearis* (Gosse), *K. cochlearis* f. *tecta* (Lauterborn), *Polyarthra remata* (Skorikov), *Bosmina coregoni* Baird, *B. longirostris* (O.F. Müller), *Ceriodaphnia quadrangula* (O.F. Müller), *Chydorus sphaericus* (O.F. Müller), *Thermocyclops oithonoides* (Sars), while only 5 dominated in the pond: *Lecane closterocerca* (Schmarda), *L. quadridentata* (Ehrenberg), *Ch. sphaericus*, *Acanthocyclops viridis* (Jurine), *Eucyclops macruioides* (Lilljeborg) (Tab. 1). So there was only one species – cladoceran *Chydorus sphaericus* – that dominated in both reservoirs.

In each case rotifers had higher densities than crustaceans in both reservoirs. The abundance of zooplankton communities differed between the examined water bodies as well as between the two examined habitats in the lake. Rotifers as well copepods reached the highest mean densities in the pond (4195 and 157 ind. l⁻¹ respectively), while cladocerans (546 ind. l⁻¹) prevailed in the cattail zone of the lake (Fig. 1). Comparing both stations within the lake it was found that total zooplankton densities were higher in the vegetated stand (2328 ind. l⁻¹) when compared with the pelagic zone (1578 ind. l⁻¹).

The mean Shannon-Weaver biodiversity index values ranged from 1.32 to 2.81 in both examined reservoirs, with the lowest values obtained for the *Ceratophyllum* zone of the pond and the highest among the *Typha* stand of the lake. The biodiversity index obtained for the open water zone reached the value of 2.10.

DISCUSSION

Different types of water bodies (lake vs. pond) may create different environmental conditions for their inhabiting organisms. However, in the case of close situation of two water bodies the biocenotic structure may often be very similar [Kuczyńska-Kippen *et al.* 2004, Kuczyńska-Kippen *et al.* 2006a, b, Milecka *et al.* 2007]. Even though the examined water bodies (pond and lake) were situated within a distance of 10 m and the pond was supplied by the lake water, both aquatic vegetation as well as the rotifer and crustacean community structure (including the taxonomical composition, zooplankton abundance and dominating species) differed significantly from each other.

The differences in the plant community structure between the examined pond and the lake are not only related to the differences in the size and depth of both water bodies. In the lake, and particularly in its southern part, aquatic plants were unable to root in strongly hydrated organic sediments which are also frequently loosened by fishing nets. The pond, contrary to the lake, is almost without an open water area owing to the overgrowing of the bottom by *Ceratophyllum demersum*. In a few parts, where no hornwort occurs, the water surface was covered by duckweed. Such a great differentiation in the aquatic plant communities should also have an impact on the zooplankton community structure.

Zooplankton composition differed greatly between both water bodies with a much richer community being found in the lake. However, the pond was infested by *Ceratophyllum demersum* so only one station was sampled here, while two stations were investigated at the lake – within the open water and the littoral zones.

Less than 40% of the taxonomical composition created a common element for both examined water bodies which suggests a quite pronounced distinctiveness of these reservoirs. Also, among the dominating species no large similarity was recorded. Only one species – the cosmopolitan *Chydorus sphaericus* [Amoros 1984] – dominated in both water bodies. This cladoceran may inhabit all the zones of a variety of water bodies, however, in shallow reservoirs it willingly inhabits beds of macrophytes, where it crawls along the plant stems [Flößner 1972].

Rotifers dominated over crustaceans in both reservoirs, which is typical for water bodies with fish predation [Pogozhev and Gerasimova 2005]. Moreover, it was found that zooplankton densities differed between the studied water bodies as well as between the two investigated habitats within the lake. Cladocerans reached the highest abundance in the rush zone of the lake, dominated by *Typha angustifolia*. Comparing both zones within the lake a pattern characteristic for lakes with planktivorous fish presence was recorded. Both rotifers and crustaceans prevailed in the cattail zone compared to the open water zone, which suggests that they found favourable concealment conditions among the macrophyte bed. The structural complexity of the vegetative stand is likely to provide a wide variety of potential refugia for zooplankton from predators [Timms and Moss 1984, Paterson 1993, Walsh 1995]. Additionally, the high diversity of plankton communities within the vegetated stands is probably connected with the fact that more physically and biologically complicated habitats there are, the more available niches are created [Currie 1991]. The mean Shannon-Weaver biodiversity index reached the highest values among the *Typha* stand of the lake.

Although both examined water bodies were situated next to each other and characterised by similar physical-chemical parameters (the pond was supplied by lake water) the structure of their zooplankton communities differed greatly due to a number of factors. The morphometric features of both water bodies (the differences in size and depth), which in turn had an impact on the physical parameters (e.g. water waving, temperature, oxygen concentration) and the differentiation of the aquatic vegetation cover which creates microhabitats for inhabiting organisms, were among the most important of these factors. The bottom of the pond was overgrown by *Ceratophyllum demersum* and 45% of its surface was covered by *Lemna* species, while in the lake the participation of submerged plants was very low and rush vegetation dominated. Moreover, the differentiation in the predator pressure (with fish dominating in the lake and mixed kinds of predators in the pond) may have also structured the zooplankton communities in both studied water bodies.

CONCLUSIONS

Even though the examined pond and lake were situated close to each other and their waters had similar chemical characteristics, both aquatic vegetation as well as the zooplankton community structure differed significantly from each other. Both these water bodies differed in the number of phytocoenoses and species of rush and water vegetation and in the dominating phytocoenoses. Zooplankton composition also differed greatly between both water bodies, with a much richer community being found in the lake. Less than 40% of the species were common to both of them. No large similarity was recorded among dominating species with only one species – *Chydorus sphaericus* – dominating in both water bodies. The morphometric features of both water bodies and the differentiation of the aquatic vegetation cover which creates microhabitats for inhabiting organisms were among the most important factors influencing the differentiation in the biocoenotic structure of the two water bodies.

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STRUKTURA BIOCENOTYCZNA DWÓCH SĄSIADUJĄCYCH ZBIORNIKÓW WODNYCH – JEZIORA I STAWU

Streszczenie. Badano strukturę zooplanktonu i roślinności w jeziorze i sąsiadującym z nim stawem. Staw (0,012 ha, głębokość = 0,5 m) położony jest 10 m od jeziora Mielno (20 ha, średnia głębokość = 1,8, maksymalna = 3,8 m) i zasilany jest woda z jeziora. W jeziorze odnotowano 25 gatunków hydromakrofitów, a dominowały fitocenozy *Thelypteridi-Phragmitetum* i *Typhetum angustifoliae*. W stawie stwierdzono 9 gatunków, a dominującym zbiorowiskiem było *Ceratophyllum demersi*. Zooplankton badano w stawie w płacie z *Ceratophyllum demersum* i w jeziorze w płacie z *Typha* i w toni wodnej. Na 64 zidentyfikowane gatunki zooplanktonu tylko 25 (39%) występowało w obu zbiornikach. Tylko jeden przedstawiciel wioślarek *Chydorus sphaericus* dominował w stawie i jeziorze. Pomimo bezpośredniej bliskości oraz wody o tych samych właściwościach chemicznych (w stawie woda z jeziora), stwierdzono znaczne różnicowanie struktury zooplanktonu i roślinności pomiędzy jeziorem a stawem. Różnice te najprawdopodobniej wynikają z wpływ morfometrii misy jeziornej, a to wpływa na różnicowanie roślinności, która tworzy dla zooplanktonu mikrosiedliska.

Słowa kluczowe: wrotki, skorupiaki, zooplankton, makrofity, litoral