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MULTIANNUAL CHANGES IN ASSEMBLAGES OF PLANKTONIC ROTIFERS IN PONDS AND OF THE POLESKI NATIONAL PARK

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Summary. One of the most interesting and less-known aquatic ecosystems of Łęczyńsko-Włodawskie Lakeland are ponds and wetlands. In three both ponds and wetlands in 2008 and then in years 2012 and 2013 rotifer assemblages were studied. A total of 57 taxa of planktonic rotifers were found. In particular reservoirs the number of species varied from 7 to 17, and the density from 8 to 161 indiv. dm^{-3}. As many as 22 of the identified species belonged to the dominants. Study was undertaken to conduct an ecological characteristics of these aquatic ecosystems and determine the dynamics of changes in the assemblages of planktonic rotifers with in 4 and 5 years. Species richness in most reservoirs characterized by considerable variability over time, while species diversity was greater stability. Stability of planktonic rotifer assemblages was higher in waters with a greater diversity of species. Planktonic rotifers were more stable in reservoirs located within the complexes, rather than individual as a „lonely" aquatic ecosystems. The density of planktonic rotifers in the wetlands was a feature more variable in time, while in the ponds greater stability of this feature was observed. Changes in the biomass of planktonic rotifers in time were not a stable feature.

Key words: pond, wetland, planktonic rotifer, Poleski National Park

INTRODUCTION

Water-bog character of the Poleski National Parka bounds with small water bodies, such as old renaturalized ponds and wetlands. Rotifers inhabiting such environment are good material for research because constitute the basic component of small zooplankton [Radwan 1974]. Planctonic rotifers as consumers of bacteria, algae, protozoans and dead organic matter play an important role in trophodynamic of water reservoirs. This group of zooplankton quite early colonize all type of water ecosystems[Hilbricht-Ilkowska *et al*. 1964, Radwan 1973, Arndt 1993]. Some of them may also be good indicators of fertility and quality of water [Karabin 1985, Radwan *et al*. 1988, Paleolog *et al*. 1997].

Study was undertaken to conduct an ecological characteristics of these less known aquatic ecosystems and determine the dynamics of changes in the assemblages of planktonic rotifers in 4 and 5 years.

STUDY AREA

The investigations have been conducted on poorly ravined lands of the Poleski National Park, which covers the most valuable natural areas of Łęczna--Włodawa Lakeland. Among them there area lot of wetlands, bogs, marshes and wetlands [Harasimiuk *et al*. 1998].

In this area were located two pond complexes – Bruskie and Pieszowolskie as well as numerous wetlands. These fish pondswere createdin the 30's, on the meadows dominated bytransition mires. Since the 70s they were allfed by waters from the Mietiułka river [Radwan 2002]. For many years, these ponds were excluded from the fishing production. During this time, they transformed intoreeds with shrubs and wooded areas (birch, alder).

Since 1990 the fishpond complexes were included into borders of the Poleski National Park, and four years later subjected to the revitalization treatments [Radwan 2002].

Studies were conducted in three ponds: pond Perkoz from complex of Bruskie ponds and two ponds Dziki and Głęboki from complex of Pieszowolskie ponds.

Perkoz pond has an area of 44.01 ha. Its catchment area covered mainly rushes (0.76 ha), shrubs (0.76 ha) and forest (36.38 ha). Ponds Głęboki and Dziki were smaller, their surface amounted 18.18 ha and 28.30 ha respectively. Their catchment areas included dykes and rushes (11.75 ha), arable lands (10.53 ha) and shrubs and woodlands (3.0 ha).

Furthermore, investigation included wetlands: Mietiułka, Radwania and Bubnów. They were of various sizes very shallow wetlands. Waters of wetlands characterized by low oxygen saturation, a diverse nutrient content and water reaction (pH) ranged from slightly acidic to slightly alkaline [Radwan 2002].

MATERIAL AND METHODS

Studies were conducted in spring and autumn in 2008 and additionally in 2012 form the wetlands and 2013 from the ponds. Samples were collected by taken 10 cm^3 of water using sampler „Toń II" from the depth 0.5 m. Each measurement was repeated three times. The water was sieved through the planktonic net no. 25 and condensed to the constant volume of 100 cm^3. Samples were preserved by Lugol`s liquid and after some hours by 4% formaldehyde with glycerine. In preserved samples planktonic rotifers were identified and counted. The normal distribution of the data was checked by Shapiro-Wilk test.

The significance of planktonic rotifers density and biomass among ponds, wetlands and different period of researches were verified using non-parametric rang test of Kruskal-Wallis using SAS Programme [SAS Institute Inc. 2001]. The similarity of rotifer communities estimated using Jaccard index and cluster analysis performed by *Multi Variate Statistical Package* – MVSP-3,1. The similarity analysis was performed using *Unweighted Pair-Group Method Using Arithmetic Avarages* – UPGMA.

The ecological analysis included: index of domination, evaluation of sustainability of domination structure [Bielańska-Grajner 2005], species diversity index of Shannon-Wiener [Shannon and Wiener 1963]. Wet biomass of planktonic rotifers WW µg dm^{-3} was calculated [Ejsmont-Karabin 1998]

RESULTS AND DISCUSSION

In studied aquatic ecosystems were found a total number of 57 taxa of rotifers. In the wetlands occurred from 5 to 12 species and in the ponds number of planktonic rotifers ranged from 10 to 17. A similar and often lower number of rotifers species occurred in otherponds from Europe and from the World [Hilbricht-Ilkowska 1964, Kyselowa 1973, Fereńska 1974, Radwan 1974, Kowalczyk *et al*. 1985, Demetraki-Paleolog 2002, Sulehria *et al*. 2012, Tayade 2013].

Few studies of rotifers from other wetlands also show low abundance of these organisms, as well as their biomass was the lowest among all groups of zooplankton not excluding protozoans.

Species richness was not a stable value in the ponds because shaped differently in 2008 than five years later. The investigated floodwaters were definitely more stable ecosystems in terms of variety of species in the following years of the study. Species diversity expressed in Shannon index both in the ponds and wetlands was very similar in the studied period (Fig. 1).

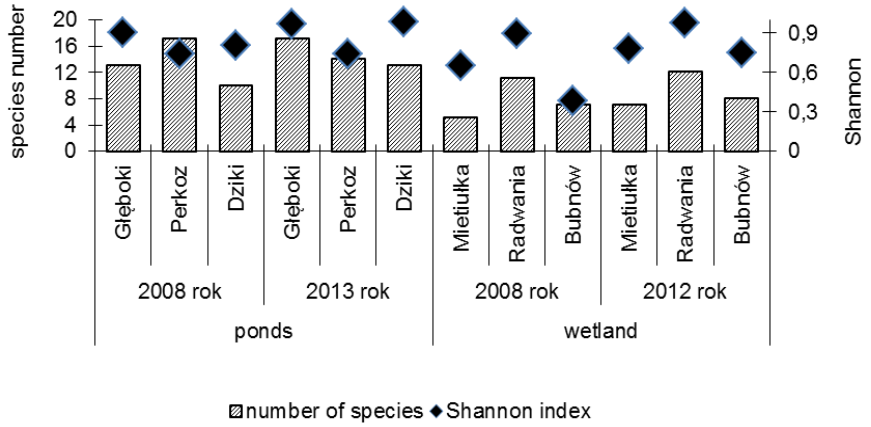

Fig. 1. Number of species and Shannon index of planctonic rotifers in investigated ponds and wetlands

In the literature there are no data about the long-term stability Shannon index calculated for rotifers in ponds and wetlands from other regions of Europe. Planktonic rotifers density was low and very characteristic for slightly fertile waters.

Density of rotifers in ponds ranged from 48 indiv. dm^{-3} to 161 indiv. dm^{-3}. Significantly lower values ranging from 8 indiv. dm^{-3} to 50 indiv. dm^{-3} occurred in the floodplains (Fig. 2). Such low density of planktonic rotifers were also observed in other reservoirs of this type [Ortega-Mayagoitia and Armengol-Rojo 2000,

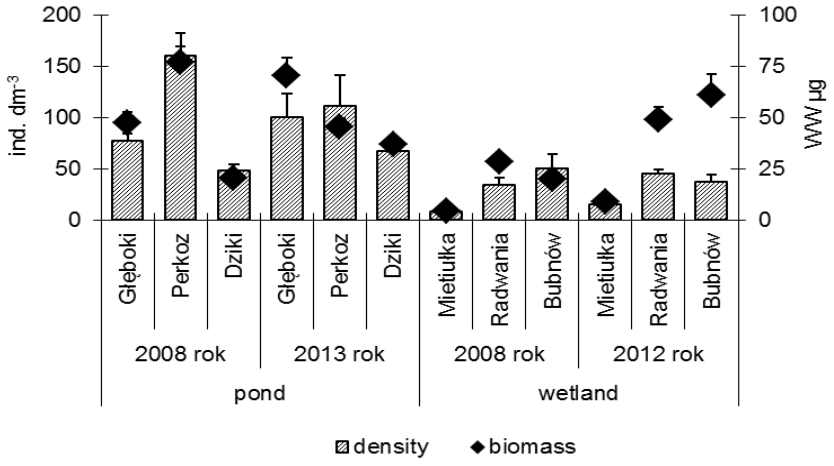

Fig. 2. Density and wet biomass (+SD) of planktonic rotifers in investigated ponds and wetlands

Table 1. Domination structure of planktonic rotifers (%) in ponds and wetlands of the Poleski National Park – 2008 and 2012/13

No.	Species	Pond						Wetland					
		2008			2013			2008			2012		
		Głęboki	Perkoz	Dziki	Głęboki	Perkoz	Dziki	Mietiułka	Radwania	Bubnów	Mietiułka	Radwania	Bubnów
	Dominant												
1	*Anuraeopsis fissa* Gosse										13.3		
2	*Brachionus quadridentatus* Herm.								8.8				
3	*Colurella adriatica* Ehrb.						8.8						
4	*Elosa spinifera* Wiszn.		13.7			26.8							
5	*Euchlanis dilatata* Ehrb.						7.4			8.0		11.1	16.2
6	*Keratella cochlearis* (Gosse)		55.9	43.8		45.5	26.5			78.0			29.7
7	*Keratella cochlearis* f. *tecta* (Gosse)								20.6			22.2	8.1
8	*Keratella quadrata* (Müll.)	24.4		12.5	30.7		7.4						
9	*Lecane acus* (Harr.)							12.5			13.3		
10	*Lecane bulla* (Gosse)	25.6			18.8								
11	*Lecane closterocerca* (Schm.)	7.7											
12	*Lecane crenata* Harr.							12.5					
13	*Lecane furcata* (Murray)										13.3		
14	*Lepadella ovalis* (Müll.)	12,8			9.9			37.5	20.6		33.3		
15	*Lepadella patella* (Müll.)											17.8	
16	*Lepadella rhomboides* (Gosse)												
17	*Lepadella triptera* Ehrb.						10.3						
18	*Macrochaetus subqudratus* Perty							25.0					
19	*Mytilina crassipes* (Lucks)							12.5			13.3		
20	*Mytilina mucronata* (Müll.)	12.8			9.9				23.5			8.9	
21	*Polyarthra euryptera* Wierz.			10.4			16.2						
22	*Polyarthra vulgaris* Carl.												29.7
	Subdominant	16.7	27.9	33.3	26.7	24.1	23.5	0.0	26.5	14.0	13.3	38.6	16.2
	Recedent	0.0	2.5	0.0	4.0	3.6	0.0	0.0	0.0	0.0	0.0	1.4	0.0

Demetraki-Paleolog 2010]. The difference between the density of rotifers in different ponds and the floodwaters as well as among different test dates in the reservoir were statistically significant. An exception was the difference in density in the backwater Mietiułka in the next years of the study. Density of rotifers in other ponds, outside the study area, was much higher [Bielańska-Grajner and Kłos 2002, Skowronek *et al*. 2012, Sulehria *et al*. 2012]. Biomass of planktonic rotifers in the studied reservoirs of the Poleski National Park was low and slightly higher in the ponds than in the wetlands (Fig. 2).

Density of planktonic rotifers slightly changed over time. Always the highest density of rotifers occurred in the pond Perkoz, and the lowest in the pond Dziki. Among the wetlands the highest values were observed in Radwania or Bubnow, and the lowest in Mietiułka.

Quite differently shaped their biomass. It was extremely unstable value (Fig. 2). Many authors argue that the species composition of plankton can be very changeable but biomass is stable. However, most such statements are based on studies of phytoplankton, and does not apply to zooplankton [Howeth and Leibold 2010, Jochimsen and Kümmerlin 2013].

Among the dominants were found up to 22 species of rotifers (38% of all identified species of rotifers). The majority, occurring in the investigated ecosystems, species belong to the common species (Tab. 1). Sustainable structure of dominance occurred only in the Głęboki pond in 2013 and in backwater Radwania in 2012. The degree of sustainability of the rotifers dominance structure measured by Bielańska-Grajner method [2005]. The assemblage is sustainable if it can be divided into three classes: dominants, subdominants and recedents, at least three species belong to the dominants and none of them does not exceed 45% of the total density.

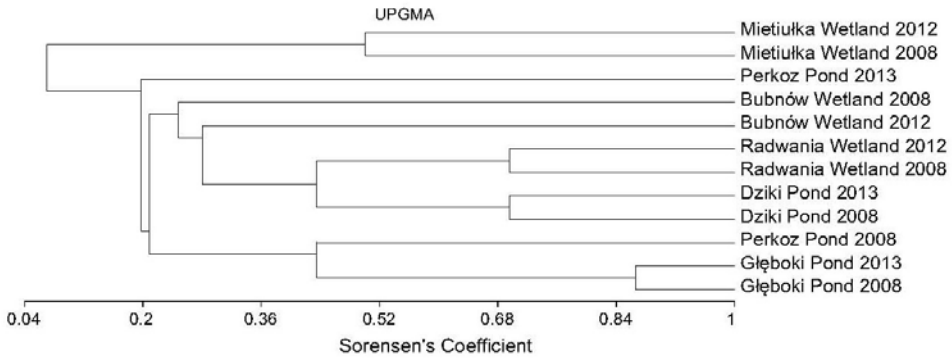

Fig. 3. Structure of planktonic rotifers similarity on the basic of quantitative structure in ponds and wetlands of the Poleski National Park – in 2008 and 2012/13

For the analysis of changes over time in species composition and structure of dominance in individual reservoirs Serensen index was calculated, it showing faunistic similarities of rotifer assemblages (Fig. 3). The cluster method showed very high similarity between rotifers inhabit the pond Głęboki in 2008 and the same pond in 2013 (Serensen's index -0.88) as well as in the pond Dziki in 2008 and 2013 year (Serensen's index -0.70). A third of the investigated ponds-Perkoz, situated in completely different way of land use in the catchment, was characterized by a much lower stability of rotifer assemblages. Serensen indicator for rotifers in this pond was only 0.20 (Fig. 3).

Many authors suggest that the less stable assemblages are associated with low species diversity [Niesler 2001]. The current study of planktonic rotifers can confirm this view because in the pond Perkoz Shannon coefficient in 2008 was the lowest among the examined ponds. The cause of much greater stability of rotifers in the pond Dziki and Głęboki could also be their location in the complex of fish ponds. Howeth and Leibold [2010] argue that the relationship between diversity and stability may be determined by the speed of spread of the species in the local community. The author gives an example of closely located ponds as the locus of a more stable meta population [Howeth and Leibold 2010, Pinsky 2010]. The dependence between the stability of rotifer assemblages and species diversity was even more evident in the wetlands. If the higher was the rate of Shannon in wetland in 2008, the smaller changes have occurred in rotifer assemblages during the four years. The highest faunistic similarity of rotifer assemblages in the wetlands, between years 2008 and 2012 was found in wetland Radwania, slightly lower in Mietiułka, and the lowest in the Bubnów. Serensen's index achieved respectively values: 0.70; 0.50; 0.26 (Fig. 3), while the Shannon index in these ecosystems was respectively 0.89; 0.64; 0.38.

More stable groups of rotifers inhabited wetlands located close to each other: Radwania and Mietiułka.

CONCLUSIONS

The studied ponds and wetlands in the Poleski National Park are very valuable aquatic ecosystems. There were no high dominance of single species there. Among the dominants occurred not common species. The small density of planktonic rotifers distinguished of studied ecosystems from most of the fish ponds and very fertile wetlands.

Research has shown that:

1. Species richness in most water ecosystems characterized by considerable variability over time, while species diversity greater stability.

2. Stability of planktonic rotifer assemblages was higher in waters with a greater diversity of species.

3. Planktonic rotifers were more stable in reservoirs located within the complexes, rather than individual as a „lonely" aquatic ecosystems.

4. The density of planktonic rotifers in the wetlands was a feature more variable in time, while in the ponds greater stability of this feature was observed.

5. Changes in the biomass of planktonic rotifers in time were not a stable feature.

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WIELOLETNIE ZMIANY ZGRUPOWANIA WROTKÓW PLANKTONOWYCH W STAWACH I ROZLEWISKACH POLESKIEGO PARKU NARODOWEGO

Streszczenie. Jednym z ciekawszych i mniej poznanych ekosystemów wodnych Pojezierza Łęczyńsko-Włodawskiego są stawy i rozlewiska. W trzech stawach i trzech rozlewiskach w 2008 r., a następnie w 2012 i 2013 r. badano zgrupowania wrotków. Łącznie w planktonie stwierdzono 57 taksonów wrotków. W poszczególnych zbiornikach liczba ich gatunków wahała się od 7 do 17, a zagęszczenie od 8 do 161 osobn. dm^{-3}. Aż 22 spośród stwierdzonych gatunków należało w poszczególnych zbiornikach do dominantów. Obserwując zmiany, jakie zaszły w planktonie w okresie 4- i 5-letnim, zastanawiano się, które z tych drobnych zbiorników są zasiedlane przez bardziej ulegające zmianom zgrupowania wrotków i jakich właściwości ekologicznych dotyczy w większym stopniu ta zmienność w czasie: bogactwa gatunkowego, różnorodności gatunkowej, zagęszczenia, biomasy, składu gatunkowego czy struktury dominacji. Wyniki badań wykazały różną, lecz niewielką zmienność cech ekologicznych zgrupowań wrotków planktonowych, zwłaszcza w stawach, oraz wskazały na zależność stabilności zgrupowań planktonowych od ich różnorodności gatunkowej.

Słowa kluczowe: stawy, rozlewiska, wrotki planktonowe, Poleski Park Narodowy