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WATER MITES (HYDRACHNIDIA) OF THE LOBELIAN KĄPKA LAKE (NW POLAND)

Abstract

Lobelian lakes are clean, oligotrophic, usually non-flow-through lakes, characterized by a small size and the presence of specific flora (*Lobelia dortmanna, Isoëtes lacustris, Litorella uniflora, Myriophyllum alterniflorum*). This type of lakes has been very rarely studied with regard to water mite fauna living in them. The aim of the present study was to partially fill the considerable existing gap in data by studying the distribution of water mites (Hydrachnidia) in the basin of a lobelian lake (Kąpka Lake) situated in Western Pomerania. The research was conducted during the period from May to August 2011, at monthly intervals. The samples were collected from the depths: 0.1 – 5–6 m. In total, 3271 specimens representing 53 water mite species were collected from the whole Kąpka Lake. The most abundant species included the following (in decreasing order): *Limnesia maculata*, *Hygrobates longipalpis*, *Lebertia porosa*, *Forrelia liliacea*, *Mideopsis orbicularis*, *Limnesia connata*, and *Limnochares aquatica*. The phenology

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of the species and their abundance in the Kąpka Lake were characterized by one peak of abundance in the month of July. At every depth of the Kąpka Lake, *Limnesia maculata* was a dominant species.

Keywords: water mites, Hydrachnidia, Acari, faunistic, ecology

Introduction

Lobelian lakes are clean, oligotrophic, usually non-flow-through lakes, characterized by a small size and the presence of specific flora (*Lobelia dortmanna, Isoëtes lacustris, Litorella uniflora, Myriophyllum alterniflorum*). The character of their catchment area results in low $CaCO_3$ content in their waters and a course of succession leading towards raised bogs. Their geographical distribution encompasses Scandinavia, Iceland, Danish and British Isles, northern regions of South America and areas reaching up to New Zealand. In Poland, most lakes of that type are situated in Pomerania (Pawlaczyk 2006), but they can also be found in other regions of the country, for instance in the Karkonosze Mountains (Piskorski 2007). This type of lakes has been very rarely studied with regard to water mite fauna living in them (Cichocka, Biesiadka 1994; Biesiadka, Cichocka 1997), and as far as Western Pomerania is concerned, just one work on the subject has been published so far (Zawal 2007).

Although the history of studies on water mites conducted in north western Poland originated in the 19th century (Zacharias, 1887; Protz, 1896; Koenike, 1898, Viets 1913; Münchberg 1935, 1936), and the newest reports come from the last years of the 20th century and the first years of the present century (Zawal 1998, 2006, 2010, 2011; Dąbkowski at al. 2007), the available information still shows considerable gaps with reference to the characteristics of water mite fauna that inhabits lobelian lakes. Those gaps regard especially the vertical distribution of water mites. Even though a number of studies discuss this aspect of water mite distribution in various types of lakes (Viets, 1930, 1931; Biesiadka, 1972, 2003 Pieczyński, 1959, 1960, 1967; Kowalik, 1973, 1977, 1984; Davids et al. 1994, Zawal et al. in press), lobelian lakes have scarcely been studied from that angle (Zawal 2007).

The aim of the present study was to partially fill the considerable existing gap in data by studying the distribution of water mites (Hydrachnidia) in the basin of a lobelian lake (Kąpka Lake) situated in Western Pomerania.

Research area and methodology

The Kąpka Lake is a lobelian lake with the area of 7.3 ha and maximum depth of 10.8 m. It is situated in Złocieniec Commune in the Drawskie Lakeland (Polish: Pojezierze Pomorskie). The lake is surrounded by a belt of reed bed (ca. 2–3 m) and forests (broad-leaved forests dominate, with an admixture of alder swamps and fresh pine forests). The bottom of the lake is sandy up to the depth of 2 m with an admixture of organic matter and pieces of rock, and beginning from the depth of 3 m and deeper it is characterized by the admixture of lake mud (gyttia).

Ten sites were selected over the area of the lake:

Site 1 – a patch of *Lobelia dortmanna* at the depth of 0.5 m, with a sandy and muddy bottom;

Site 2 – sandy littoral at the depth of 0.5 m, near a small beach;

Site 3 – a patch of *Isoëtes lacustris* at the depth of ca. 1 m, with a sandy bottom;

Site 4 – a bay with the bank overgrown by *Sphagnum*, at the depth of ca. 0.2 m, with a sandy bottom and detritus;

Site 5 – a patch of *Glyceria aquatica* at the depth of ca. 0.2 m, with a bottom covered with organic matter (tree leaves, dead shoots of *Glyceria*);

Site 6 – a patch of sparsely growing *Lobelia dortmanna* at the depth of ca. 0.2 m, with a sandy and muddy bottom;

Site 7 – a patch of *Lobelia dortmanna* at the depth of ca. 0.2 m, with a sandy bottom and a small amount of mud;

Site 8 – a patch of *Isoëtes lacustris* and *Lobelia dortmanna* at the depth of ca. 1 m, with gravelly and muddy bottom;

Site 9 – an astatic zone in front of the patch of *Glyceria aquatica* at the depth of ca. 0.1 m, with a leaf-covered bottom;

Site 10 – an astatic zone next to the patch of *Sphagnum* at the depth of ca. 0.1 m, with a leaf-covered bottom.

The research was conducted during the period from May to August 2011, at monthly intervals. The samples were collected from the following depths: 0.1;

0.2; 0.5; 1; 2; 3–4 and 5–6 m. Down to the depth of 1 m the samples were collected with the aid of a hydrobiological sweep net, and from greater depths with the aid of a dredge towed from a boat. Live material was preserved in alcohol, then microscopic slides were prepared and duly labeled.

Results

In total, 3271 specimens representing 53 water mite species were collected from the whole Kąpka Lake (Tab. 1).

The most abundant species included the following (in decreasing order): *Limnesia maculata*, *Hygrobates longipalpis*, *Lebertia porosa*, *Forrelia liliacea*, *Mideopsis orbicularis*, *Limnesia connata*, and *Limnochares aquatica* (Tab. 1). The following species had the highest frequencies (%) in the research sites: *Limnesia maculata, Hygrobates longipalpis, Limnochares aquatica, Piona coccinea, Forelia liliacea,* and *Arrenurus albator* (Tab. 1).

Table 1. Composition of the whole material (1-14 numbers of posts) (A – deutonymph, B – domination, C – attendance at position, D – attendance at rehearsals)

N.o.	Species	♂	♀	A	∑	B %	C %	D %	0,1 m		0,2 m		0,5 m		1 m		2 m		3–4 m		5–6 m	
									l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%
1	Limnochares aquatic Latr.				53	3.5	85.7	33.9	5	1.2	29	7	5	1	13	3					1	0
2	Hydrachna cruenta Müll.			1	1	0.1	7.1	1.8	1	0.2												0
3	Hydrachna globosa (de Geer)	2			2	0.1																
4	Thyas barbigera Viets		1		1	0.1	7.1	1.8	1	0.2												
5	Hydryphantes ruber (de Geer)	2	1		3	0.2	7.1	1.8	3	0.7												
6	Hydrodroma despiciens (Müll.)	10	10		20	1.3	57.1	16.1	2	0.5	6	1	2		6	1					1	
7	Lebertia insignis Neum.	10	10		20	1.3	14.3	8.9							20	5						
8	Lebertia porosa Thor	24	57		81	5.3	57.1	17.9	4	0.9	9	2	2				1	0.2	3	1	1	
9	Lebertia ineaqualis (Koch.)	3	3		6	0.4	28.6	10.7	1	0.2	3	1	2					0				

N.o.	Species	♂	♀	A	∑	B %	C %	D %	0,1 m		0,2 m		0,5 m		1 m		2 m		3–4 m		5–6 m	
									l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%
10	Oxus ovalis (Müll.)	1	4		5	0.3	7.1	3.6										0	5	1		
11	Oxus angustipositus Viets		3		3	0.2	7.1	1.8			3	1						0				
12	Frontipoda musculus (Müll.)	7	27		34	2.2	28.6	10.7							1		5	1.2	26	6	2	
13	Limnesia undulata (Müll.)		1		1	0.1	7.1	1.8							1							
14	Limnesia maculata (Müll.)	352	445		797	52.5	100.0	91.1	107	24.8	197	46	99	23	116	27	56	13	119	28	103	24
15	Limnesia connata Koen.			62	62	4.1	21.4	5.4							50	12	6	1.4	6	1		
16	Hygrobates longipalis (Herm.)	39	47		86	5.7	100.0	53.6	7	1.6	28	6	20	5	23	5	3	0.7	3	1	2	
17	Unionicola crassipes (Müll.)	3	9		12	0.8	7.1	3.6											12	3		
18	Neumania vernalis (Müll.)	1	3		4	0.3	7.1	1.8					4	1								
19	Tiphys latipes (Müll.)		2		2	0.1	7.1	1.8			2											
20	Tiphys torris (Müll.)		1		1	0.1	7.1	1.8			1											
21	Piona carnea Walter		1		1	0.1	7.1	1.8	1	0.2												
22	Piona coccinea (Koch)	17	33		50	3.3	71.4	26.8			3	1	4	1	14	3	8	1.9	18	4	3	1
23	Piona stjoerdalensis (Thor)	7	29		36	2.4	21.4	8.9									15	3.5	20	5	1	
24	Piona longipalpis (Krend.)	3	13		16	1.1	28.6	8.9	1	0.2			1		1		13	3				
25	Piona pusilla (Neum.)		6		6	0.4	7.1	1.8					6	1								
26	Piona rotundoides (Thor)		1		1	0.1	7.1	1.8					1									
27	Piona conglobata (Koch)	1	27		28	1.8	57.1	23.2	6	1.4	12	3	7	2	1						2	
28	Piona paucipora (Thor)		2		2	0.1	7.1	1.8									2	0.5				
29	Piona variabilis (Koch)	1	5		6	0.4	7.1	1.8					6	1								
30	Piona dispersa Sok.		2		2	0.1	7.1	1.8					2									

N.o.	Species	♂	♀	A	∑	B %	C %	D %	0,1 m		0,2 m		0,5 m		1 m		2 m		3–4 m		5–6 m	
									l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%
31	Forelia liliacea (Müll.)	1	70		71	4.7	78.6	5.,0	14	3.2	16	4	28	6	10						3	1
32	Forelia variegator (Koch)		2		2	0.1	7.1	1.8							2							
33	Brachypoda versicolor (Müll.)	4	43		47	3.1	21.4	7.1					5	1			26	6	16	4		
34	Midea orbiculata (Müll.)	1	15		16	1.1	7.1	1.8									16	3.7				
35	Mideopsis orbicularis (Müll.)	4	60		64	4.2	50.0	21.4	1	0.2	6	1	15	3	16	4	14	3.2	12	3		
36	Arrenurus cuspidator (Müll.)		2		2	0.1	7.1	1.8											2			
37	Arrenurus maculator (Müll.)	1	4		5	0.3	7.1	1.8							5	1						
38	Arrenurus tetracyphus Piers.		1		1	0.1	7.1	1.8	1	0.2												
39	Arrenurus claviger Koen.		1		1	0.1	7.1	1.8							1							
40	Arrenurus tricuspidator (Müll.)		2		2	0.1	7.1	1.8	2	0.5												
41	Arrenurus affinis Koen.		1		1	0.1																
42	Arrenurus neumani Piers.	1	7		8	0.5	7.1	3.6									8	1.9				
43	Arrenurus albator (Müll.)	3	42		45	3.0	64.3	25.0	5	1.2	7	2	4	1	5	1	24	5.6				
44	Arrenurus globator (Müll.)	1	2		3	0.2	21.4	5.4			2				1							
45	Arrenurus tubulator (Müll.)	3	2		5	0.3	14.3	3.6			1										4	1
46	Arrenurus perforatus George		2		2	0.1	7.1	1.8					2									
47	Arrenurus forpicatus Neum.		3		3	0.2	7.1	1.8											3	1		
48	Arrenurus sinuator (Müll.)		3		3	0.2	7.1	1.8					3	1								
49	Arrenurus biscissus Lebert	1			1	0.1	7.1	1.8													1	

N.o.	Species	♂	♀	A	∑	B %	C %	D %	0,1 m		0,2 m		0,5 m		1 m		2 m		3–4 m		5–6 m	
									l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%	l.o.	%
50	Arrenurus inexploratus Viets		2		2	0.1	7.1	1.8			2											
51	Arrenurus stjoerdalensis Thor	2	3		5	0.3	21.4	7.1			2		1								2	
52	Arrenurus bifidicodulus Piers.		3		3	0.2	7.1	1.8			3	1										
53	Arrenurus stecki Koen.		1		1	0.1	7.1	1.8	1	0.2		0										
	Deutonymphs			1387	1387				269		257		96		331		91		59		220	
	Larvae				1																	
	Total	505	1014	1450	3023				432		589		315		617		288		304		346	

The phenology of the species and their abundance in the Kąpka Lake were characterized by one peak of abundance in the month of July (Fig. 1). It was built up mainly by *Limnesia maculata*, which was the most abundant species also in the remaining months and to a lesser degree by such species as *Limnesia connata*, *Lebertia porosa*, *Hygrobates longipalpis* and *Brachypoda versicolor* (Fig. 2).

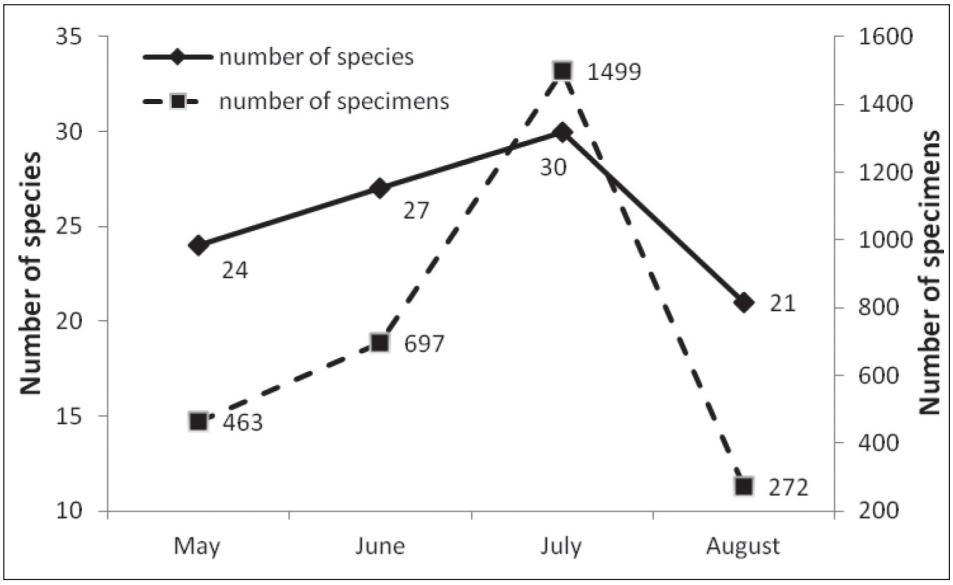

Fig. 1. Phenology of water mites

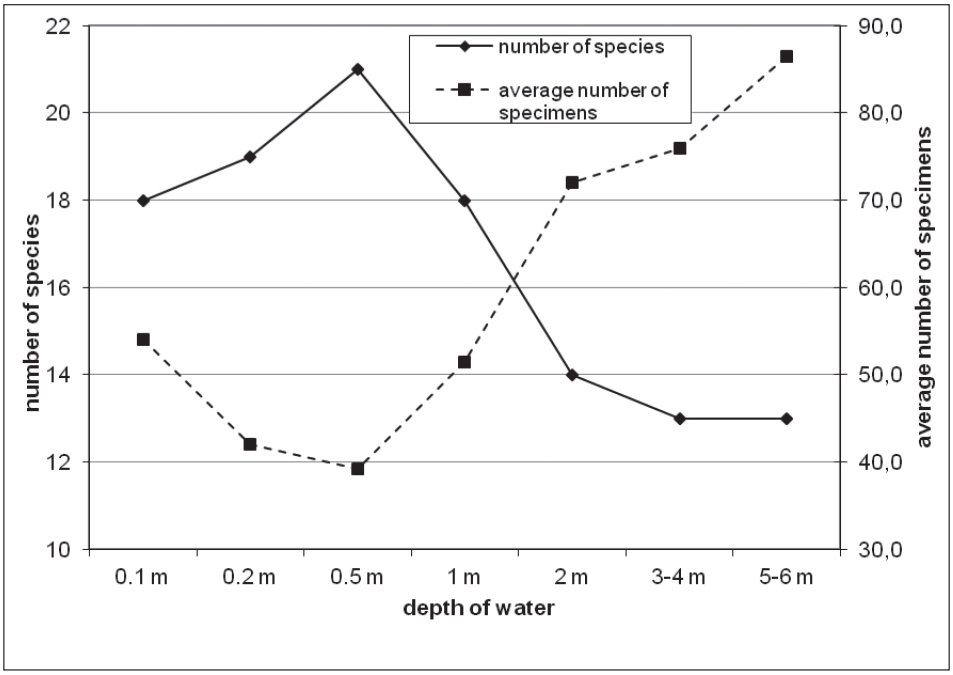

Fig. 2. Distribution of water mites in profile of lake Kąpka

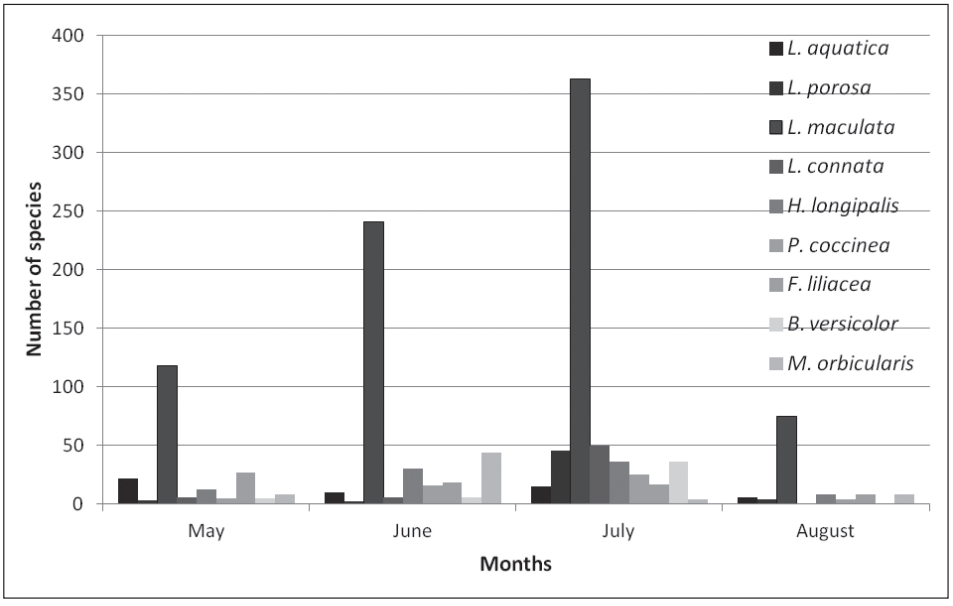

Fig. 3. Phenology of particular species of water mites

Beginning from the depth of 0.5 m and deeper, the average number of water mite individuals increased, whereas the species diversity decreased. The fauna of water mites inhabiting lobelian lakes is not characterized by high species richness because the phytolittoral of such lakes is not very diversified. In the shallow littoral (0.1–0.5 m) the number of species was higher than an average number of individuals. Deeper into the littoral (1–2 m) the situation was gradually becoming reversed, whereas in the deep littoral (3–6 m) it was completely reversed in comparison to the shallow littoral (Fig. 3).

The highest number of water mite species was found at the depth of 0.5 m, while the lowest number of species was discovered at the depths of 3–4 m and 5–6 m. The average number of species was the highest at the depth of 5–6 m, and the lowest at the depth of 0.5 m (Fig. 3).

In particular months (May, June, July and August), species diversity in the shallow littoral was higher than the average number of individuals. In the deep littoral the number of individuals exceeded the number of water mite species (Figs 4, 5, 6 and 7). The difference was the most striking in May and in August

(Figs 4 and 7). Water mite distribution across the lake profile was connected with a growth of temperature in deeper areas. It was stated that in May, June and August the number of individuals was much lower than in July (Figs 4, 5, 6 and 7).

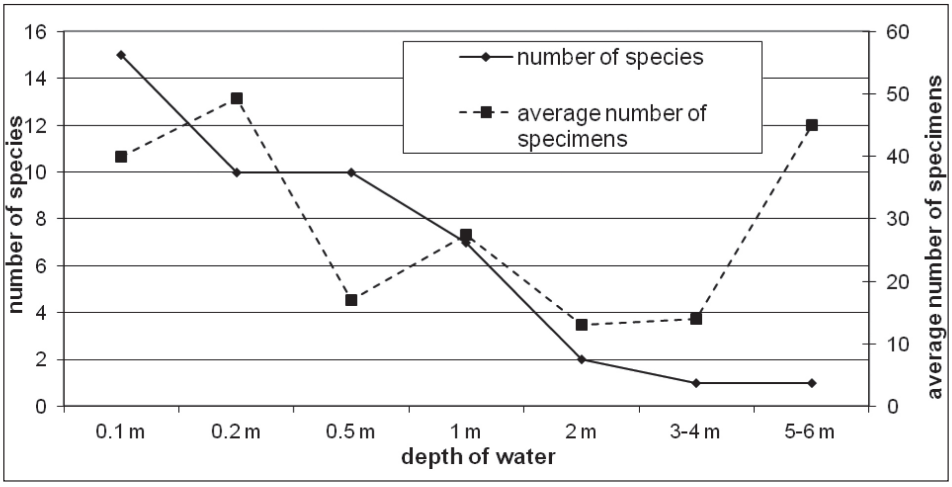

Fig. 4. Distribution of water mites in profile of the lake in May

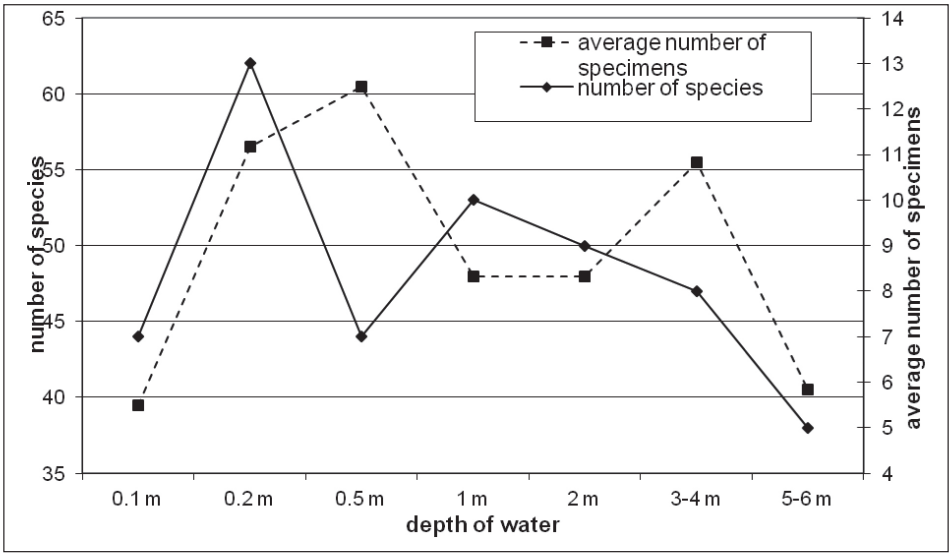

Fig. 5. Distribution of water mites in profile of the lake in June

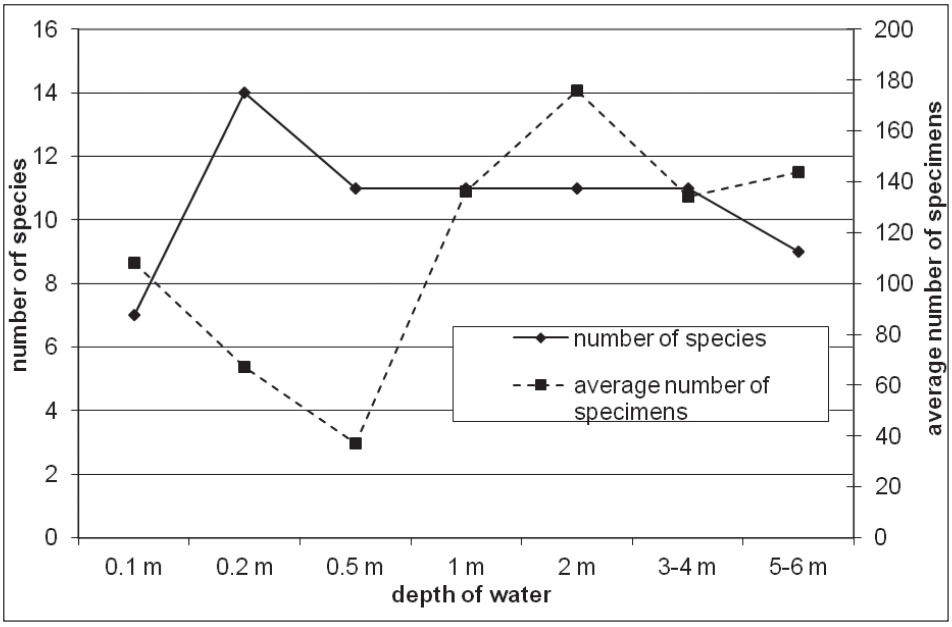

Fig. 6. Distribution of water mites in profile of the lake in July

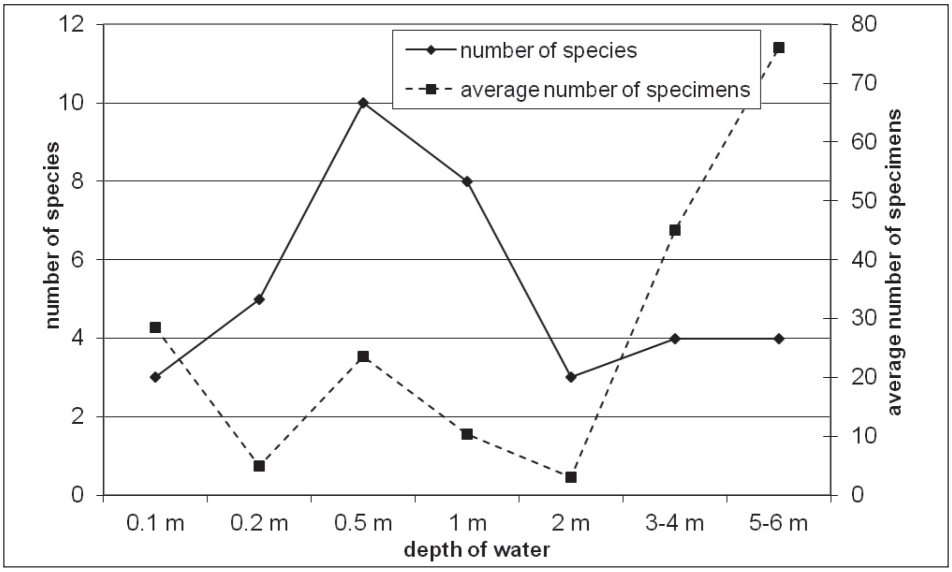

Fig. 7. Distribution of water mites in profile of the lake in August

At every depth of the Kąpka Lake, *Limnesia maculata* was a dominant species (Fig. 8).

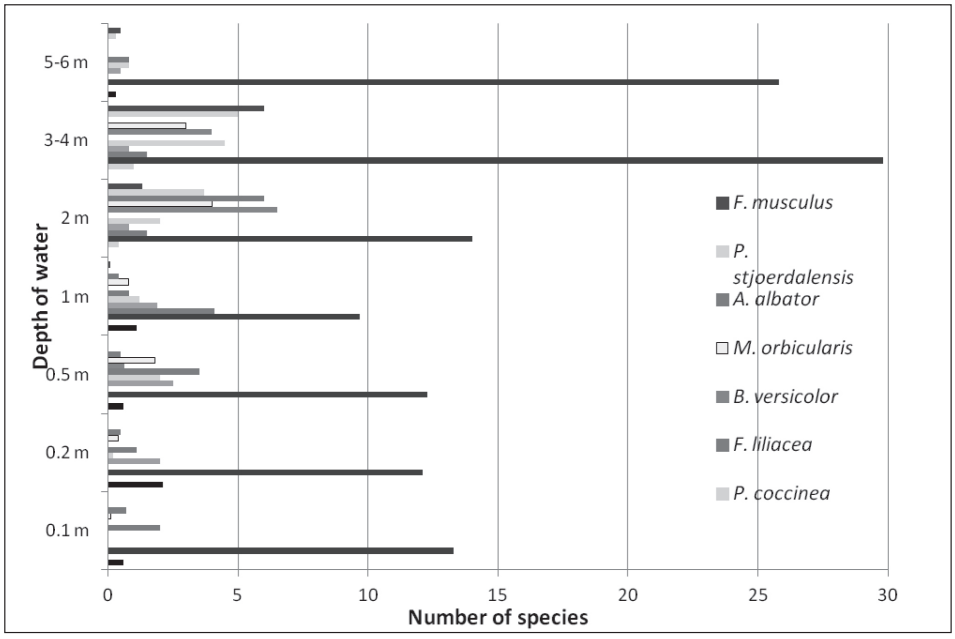

Fig. 8. Distribution of most common species in profile of the lake

The most numerous water mite species among those that inhabited the Kąpka Lake included species characteristic for small water bodies and lakes (Figs 9, 10, 11 and 12). The prevalence of species characteristic for small water bodies had also been reported by Zawal, who studied the Szare Lake (Zawal 2007) and some lakes in the surroundings of Poznań (Zawal 1992). In lobelian lakes, where the phytolittoral was not very diversified, there had been observed the prevalence of lake species over those characteristic for small water bodies (Cichocka, Biesiadka 1994; Biesiadka, Cichocka 1997). The latter group of species inhabited the phytolittoral, whereas lake species preferred the sublittoral and profundal. In the Kąpka Lake the species characteristic for small water bodies dominated due to the presence of *Limnesia maculata* and *Forelia liliacea* (Tab. 1). In subject literature many reports can be found about a comparable number of species characteristic for water bodies and for lakes (Pieczyński 1959; Kowalik 1977; Biesiadka 1994; Viets 1930; Davids 1994).

Much fewer acidophilous and astatic water mite species were recorded (the highest number of individuals was recorded at the depth of 1 m – Fig. 11) and much fewer reophilous species. In the latter case, the highest numbers of individuals were noted at the depths of 0.2 and 3–4 m (Fig. 11). As for acidophilous and astatic species, the highest numbers of individuals were encountered at the depth of 1 m. As for the species characteristic for small water bodies and reophilous species, their diversity was the highest at the depth of 1 m (Fig. 12) and the lowest in the sublittoral.

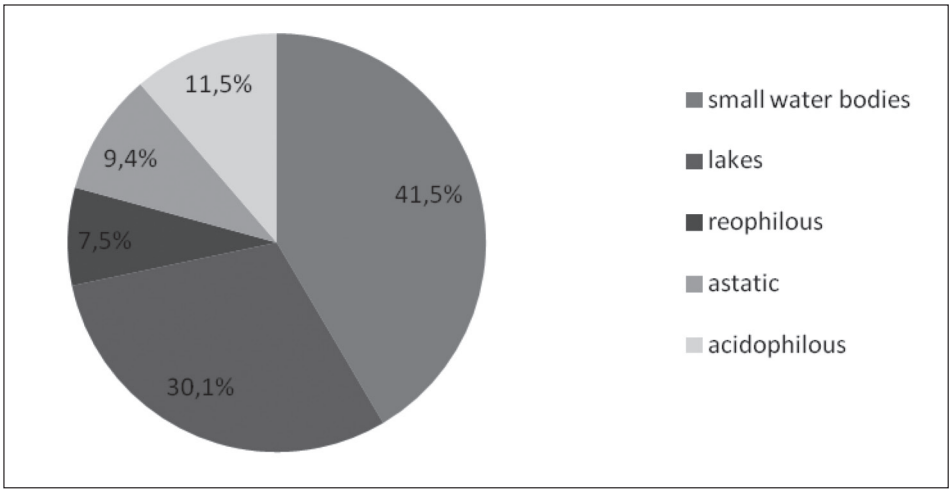

Fig. 9. The participation of water mite species in different ecological group

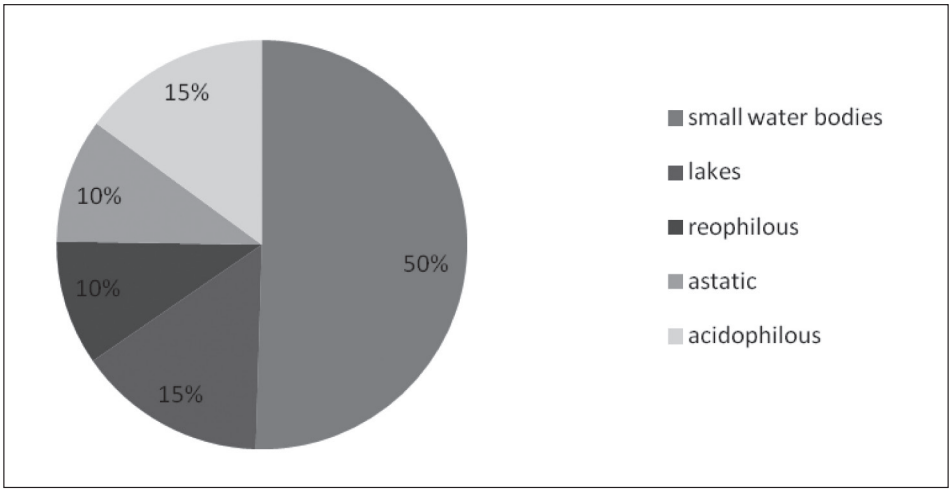

Fig. 10. The participation of water mite specimens in different ecological group

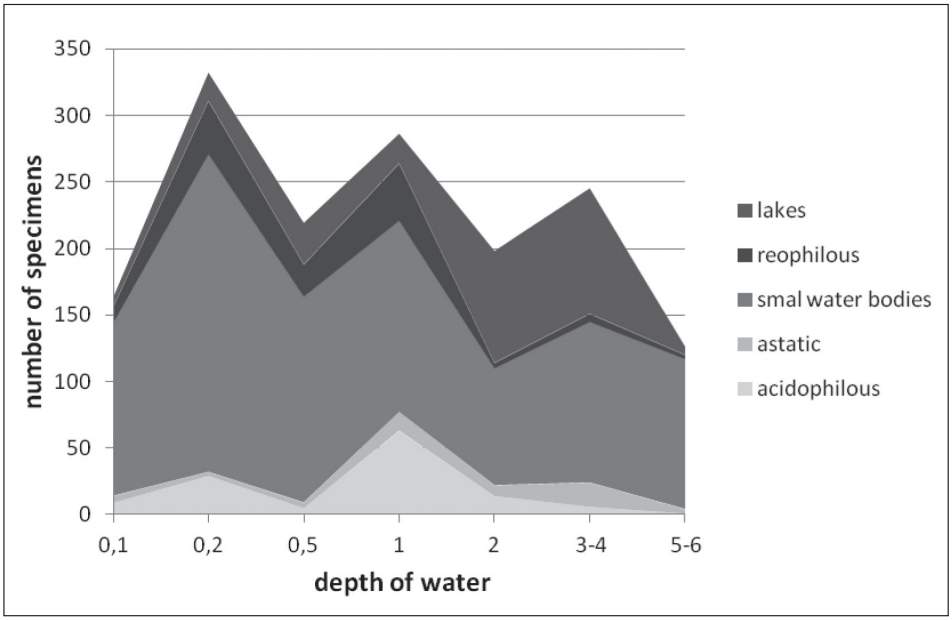

Fig. 11. Distribution of specimens of different ecological status in profile of the lake

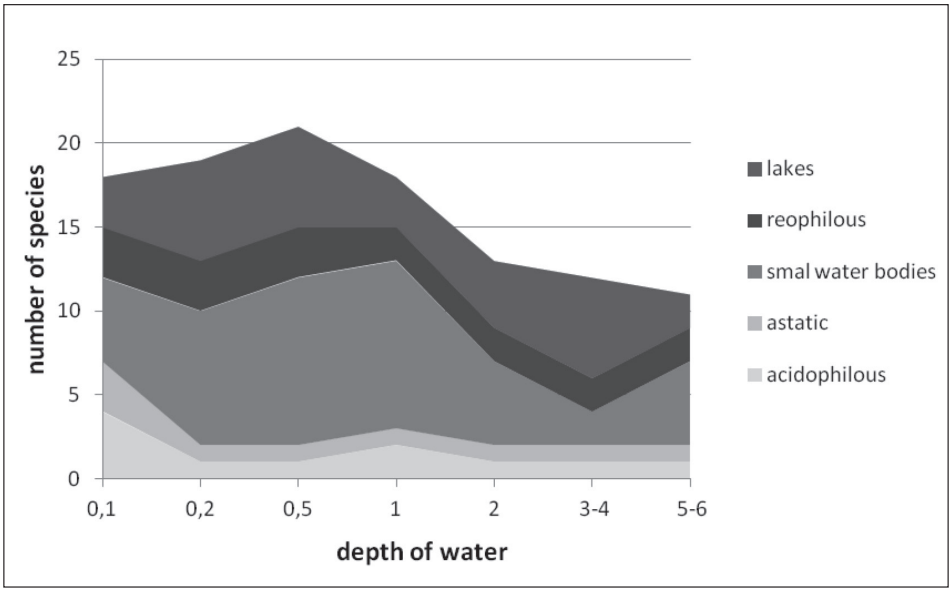

Fig. 12. Distribution of species of different ecological status in profile of the lake

Discussion

The level of species diversity of water mites from the Kąpka Lake was medium high. The highest species diversity of water mites has so far been recorded in the Tuczno Lake, where 96 species were encountered (Biesiadka 2003). Polish lakes characterized by a high number of water mite species also include the Tyrsko Lake – 73 species (Cichocka, Biesiadka 1994), and Szare Lake – 62 species (Zawal 2007); a lower diversity level was observed in the Mikołajskie Lake – 42 species (Pieczyński 1964), Śniardwy Lake – 42 species (Pieczyński 1967), Cechyńskie Małe Lake – 44 species, Łąkie Lake – 40 species (Biesiadka, Cichocka 1997), and Białe Włodawskie Lake – 40 species (Biesiadka, Kowalik 1991); and the following were among the lakes with the lowest diversity level: Głęboczko Lake – 35 species (Biesiadka, Cichocka 1997) Czarne Lake – 24 species, (Cichocka, Biesiadka 1994**)** and others (Pieczyński 1963, 1964; Biesiadka 1972; Kowalik 1978, 1992; Kowalik, Stryjecki 1999). On the basis of the above studies it can be concluded that there exists a relationship between habitat diversity in the littoral and species diversity of water mite fauna (Zawal 2007). As the phytolittoral of lobelian lakes is not very diversified, they are often characterized by the presence

of a small number of water mite species (Cichocka, Biesiadka 1994; Biesiadka, Cichocka 1997). The Tyrsko Lake was an exception (Cichocka, Biesiadka 1994), because as a result of eutrophization the sedge bed and reed field had expanded and contributed to an increase in the number of water mite species.

In light of the above information it can be concluded that the bigger the size and the higher the diversity of habitats in a non-eutrophized lake, the more its species biodiversity increases. The Kąpka Lake has a small area and is characterized by a rather high abundance of water mites in comparison to other lobelian lakes. More water mite species have been recorded only in the following Polish lakes: Tyrsko Lake – 73 species (Cichocka, Biesiadka 1994) and Szare Lake – 62 species (Zawal 2007). Analyzing species diversity of water mites in lobelian lakes on the basis of obtained data and data from literature it is not possible to unequivocally identify the reasons why the level of biodiversity is higher or lower. Treating the Tyrsko Lake, which is on the border between mesotrophy and eutrophy, as an example (Cichocka, Biesiadka 1994) it can be concluded that slightly growing lake trophy contributes to habitat diversification and also to an increase of the number of water mite species. The above conclusion has been confirmed by results obtained with reference to the Kąpka Lake, which trophy has been lately growing due to the development of tourist industry. A drop in the number of water mite species was noted as a result of acidification, e.g. in the Łąkie Lake – 40 species (Biesiadka, Cichocka 1997) and the Czarne Lake – 24 species (Cichocka, Biesiadka 1994). On the other hand, research conducted in the Szare Lake (Zawal 2007) did not confirm the thesis assuming that a drop in water mite biodiversity was the result of acidification of the water body. The Szare Lake was characterized by a high species diversity (62 species) while the pH was very low (3.8 in some parts of the lake). Species richness of the Szare Lake was probably due to the presence of expansive astatic zones, where the presence of water mites associated with such zones was recorded (Zawal 2007).

Species associated with lakes and slow-flowing water courses *Hygrobates longipalpis*, *Lebertia porosa*, *Mideopsis orbicularis*) as well as species characteristic for small water bodies (*Limnesia maculata*) were among the most abundant and the most frequent species. Such species composition was typical for comparatively clean lakes on the border of mesotrophy and eutrophy. At the same time the numerous presence of species associated with the phytolittoral (*Limnesia maculata*, *Forrelia liliacea*, *Limnesia connata*, *Piona coccinea*), sandy littoral (*Mideopsis orbicularis*, *Arrenurus albator*), and a dark, muddy bottom

(*Limnochares aquatica*) were proof of a considerable environmental diversification within the studied lake. A clearly dominant species at all depths was *Limnesia maculata*, characteristic for small water bodies. In the Kąpka Lake, similarly to the Maarsseven Lake (Davids 1994), domination of *Limnesia maculata* was observed in the littoral zone in May, and in the subsequent months it was observed in deeper zones of the lake. Davids (1994) explained this phenomenon either by the period of reproduction taking place in shallow waters or by intense foraging at the bottom of the littoral. *Limnesia maculata* was the most abundant and the most common water mite species in Wielkopolska National Park (Biesiadka 1972). The species was also present in large numbers in the Cechyńskie Małe Lake (Biesiadka, Cichocka 1997), Głęboczko Lake (Biesiadka, Cichocka 1997) and Tyrsko Lake (Cichocka, Biesiadka 1994). On the other hand, very low numbers of *Limnesia maculata* were reported from the Szare Lake (Zawal 2007) and Łąkie Lake (Biesiadka, Cichocka 1997). Probably, the absence from the Szare Lake of some species characteristic for small water bodies was due to low diversification of its littoral and a low pH of neritic waters (Stępień 2007; Zawal 2007). *Hygrobates longipalpis* and *Mideopsis orbicularis*, both of which are psammophilous species, were among the most frequent in the Kąpka Lake, while in the Szare Lake their presence was not recorded (Zawal 2007). *Hydrodroma despiciens*, a species characteristic for small water bodies, was not numerous in the Kąpka Lake. However, this water mite species, characterized by a wide ecological range, was the most abundant species in the Szare Lake (Zawal 2007). Also in the Cechyńskie Małe Lake (Biesiadka, Cichocka 1997) and Tyrsko Lake (Cichocka, Biesiadka 1994), high numbers of *Hydrodroma despiciens* representatives were encountered.

Phenology of the species and their abundance in the Kąpka Lake were characterized by one peak of abundance in the month of July (Fig. 1). That peak was built up mainly by *Limnesia maculata*, which was the most abundant species in the remaining months as well, and to a lesser degree also by *Limnesia connata*, *Lebertia porosa*, *Hygrobates longipalpis* and *Brachypoda versicolor* (Fig. 2). No spring peak was observed, since the Kąpka Lake had no astatic zones where the abundance of water mites characteristic for astatic waters would grow at that time. Only the summer peak was also observed by Pieczyński (1959) during his study of the Tajty Lake, but in that case it was due to the commencement of research in June. Two peaks (in summer and in spring) were observed in the Sosnowickie Lakes and the Piaseczno Lake by Kowalik (1973, 1977). Biesi-

adka (1972) reported the occurrence of two peaks: a spring/summer one and an autumn one in the Góreckie Lake. Well-developed astatic zones were found in the lakes where the summer peak occurred (Kowalik 1973, 1977; Biesiadka 1972); such zones were absent from the Kąpka Lake. Spring culmination of water mite fauna was connected with intense maturing of females which laid a large number of eggs and then died out. Larvae that hatched from the eggs parasited mayflies, true bugs, caddisflies, flies, bivalves and sponges. Then the larvae developed into nymphs, which either matured and contributed to the summer culmination (early-autumn peak) or hibernated (Biesiadka 1972; Hopkins 1962; Kowalik 1977; Pieczyński 1961). Larval and imago stages of water mites were characterized by high mortality rates (Kowalik 1984). Thus, the absence of the spring peak in the Kąpka Lake could also be due to the fact that a majority of larvae and imagoes either died out or were eaten during the winter. It was also possible that the parasitic stages of water mites were transferred to another water body by winged insects that were their hosts at the time.

Water mites inhabit the whole lake basin, but in the profundal their fauna is poor and the characteristic species are absent (Biesiadka 1972). In spite of their activeness and considerable mobility, water mites are strongly associated with the bottom of a water body (Pieczyński 1956). The highest number of species lives in the phytolittoral, as was observed in the Czarne Sosnowickie Lake (Kowalik 1973) and Piaseczno Lake (Kowalik 1977). The greater the depth of the lake, the lower the number of water mite species, with maximum density at 1-3 m (Viets 1924; Tutaj 1936; Pieczyński 1964; Biesiadka 1972, 1977). The shallow phytolittoral of the Kąpka Lake contributed to the fact that the highest abundance of water mites was recorded in the profundal. Similar results had been obtained from the Lubie Lake (Zawal, Szlauer-Łukaszewska, in press), where the highest abundance of water mites had been encountered in the sublittoral. In the Lubie Lake the reason for a growth in the number of individuals was a low position of thermocline which facilitated free flow of water mites to deeper zones of the lake. It is possible that the low position of thermocline also affected the abundance of water mites in the Kąpka Lake. A growth in the number of water mites at the depth of 3-5 m was also recorded in the lobelian Łąkie Lake (Biesiadka, Cichocka 1997). In the dystrophic Czarne Lake (Cichocka, Biesiadka 1994), the highest number of water mites was recorded in the shallow littoral. In lakes with wide phytolittoral (Zawal 2007), the zones of the lake that were the closest to the

surface were characterized by the highest number of water mites, with astatic species dominating among them.

In the spring period the number of water mite species was the highest in shallow layers of the Kąpka Lake. Similar results had been obtained by Zawal et al. (in press) who studied the Lubie Lake, and by Biesiadka (1972). A drop in the number of water mite species in the shallow littoral in the summer period may be caused by a drop in abundance of the spring species, and in autumn – by water running dry. In deeper layers of the lake the number of individuals was higher. Similar data were obtained by Zawal and Szlauer-Łukaszewska (in press). The highest abundance of water mites in deep layers of the lake was recorded towards the end of summer. The phenomenon could be caused by the fact that the water became warm in the summer period and the position of the thermocline was lowered. When the water temperature above and below the thermocline became similar, it facilitated the penetration of deeper water layers by water mites (Zawal, Szlauer-Łukaszewska, in press). Towards the end of summer, in samples collected from the Wielkopolska National Park, Biesiadka (1972) found a higher number of species and a lower number of individuals in comparison to samples collected in spring. Similar results were obtained by Schieferdecker (1966) in Mecklenburg. On the other hand, analyzing samples collected from the Kierskie Lake, Tutaj (1936) discovered that in summer there were fewer water mite species and more individuals in comparison to spring. The reason why Tutaj (1936) obtained such results could be the fact that research stations were distributed unevenly, e.g. a lower number of samples were collected from astatic water bodies (Biesiadka 1972). Studying the lakes of Holstein, Viets (1930) proposed a hypothesis that water mites migrated twice a year: to the littoral in spring and to deeper zones of the lake in autumn. This hypothesis was confirmed by the presence of the highest number of water mites in the littoral in late spring and summer, and a lower number of water mites in deeper zones of the lake during the later period (Biesiadka 1972; Kowalik 1973, 1977; Pieczyński 1964; Tutaj 1936; Viets 1930). The drop in species diversity in autumn and winter was explained by Kowalik (1973) either by dying out of water mites or by their dispersal over the bottom. Most species hibernated as nymphs. Some, however, hibernated as adult forms, e.g. *Mideopsis orbicularis, Brachypoda versicolor, Hydrodroma despiciens* and *Limnesia maculata* (Biesiadka 1972). Water mites probably spend winter in the profundal (Viets 1930; Tutaj 1936; Pieczyński 1964; Kowalik 1973).

In lobelian lakes, where the phytolittoral is not very diversified, the prevalence of lake species over species characteristic for small water bodies has been observed (Cichocka, Biesiadka 1994; Biesiadka, Cichocka 1997). The species characteristic for small water bodies inhabit the phytolittoral, while the lake species prefer the littoral, sublittoral and profundal. In the Kąpka Lake the former species dominated due to the presence of *Limnesia maculata* and *Forelia liliacea* (Tab. 1), in spite of poorly developed phytolittoral. In the Szare Lake the dominance of species characteristic for small water bodies was mainly due to the presence of *Hydrodroma despiciens* (Zawal 2007). In subject literature many reports can be found about comparable numbers of species characteristic for small water bodies and for lakes (Pieczyński 1959; Kowalik 1977; Biesiadka 1994; Viets 1930; Davids 1994). According to Kowalik (1983), the progressing eutrophication of the Łęczyńsko-Włodawskie Lakes led to the impoverishment of the lake fauna of water mites. First of all, rare, relic and deep-water lake species were eliminated. Simultaneously, species characteristic for small water bodies which lived in the lush phytolittoral vegetation become more abundant (Kowalik 1983). Similar changes in the species structure of water mites were recorded in the strongly eutrophicated Zbęchy Lake (Biesiadka 1981).

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WADOPÓJKI (HYDRACHNIDIA) LOBELIOWEGO JEZIORA KĄPKA (PŁN.–ZACH. POLSKA)

Streszczenie

Jeziora lobeliowe są czystymi, z reguły nieprzepływowymi jeziorami oligotroficznymi o niewielkiej powierzchni oraz specyficznej florze (*Lobelia dortmanna, Isoëtes lacustris, Litorella uniflora, Myriophyllum alterniflorum*). Jeziora tego typu były bardzo rzadko badane pod kątem charakterystyki zasiedlającej je fauny wodopójek. Celem niniejszego artykułu jest częściowe uzupełnienie tej wyraźnej luki na podstawie badań rozmieszczenia wodopójek (Hydrachnidia) w misie jeziornej jeziora lobeliowego (Kąpka) położonego na Pomorzu Zachodnim. Badania przeprowadzono w okresie od maja do sierpnia w 2011 roku w miesięcznych odstępach. Połowów dokonano na głębokościach od 0,1 do 5–6 m. Łącznie na terenie Jeziora Kąpka zebrano 3271 osobników należących do 53 gatunków wodopójek. Do najliczniejszych gatunków należały w kolejności: *Limnesia*

maculata, *Hygrobates longipalpis*, *Lebertia porosa*, *Forrelia liliacea*, *Mideopsis orbicularis*, *Limnesia connata*, *Limnochares aquatica*. Fenologia gatunków i ich liczebności w Jeziorze Kąpka charakteryzowała się jednym szczytem w miesiącu lipcu. Na każdej głębokości Jeziora Kąpka gatunkiem dominującym była *Limnesia maculata.*
Słowa kluczowe: wodopójki, Hydrachnidia, Acari, faunistyka, ekologia

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