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Hydracarina fauna in *Lobelia*-type lakes near Bytów

Abstract. 63 species of water mites recorded in three *Lobelia*-type lakes. Three species: *Eylais relicta*, *Lebertia saxonica*, *Arrenurus vietsi* were new for Poland. The fauna of investigated lakes is strongly individualized. The water mites fauna of Lake Łąkie were dominated by acidophilic species. In the Lake Głęboczko the indicators of oligo-mesotrophy and moderate eutrophy are the most numerous. The species of small water bodies and eurytopic were the most numerous in the Lakes Cechyńskie Małe and Głęboczko. This situation is results of growing eutrophy.

Key words: water mites, *Lobelia*-type lakes, acidification, indicators of trophy, faunistical similarity.

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INTRODUCTION

Lobelia-type lakes are very special water bodies in which low content of nutrients is coupled with abundant occurrence of such plants as *Lobelia dortmanna*, *Isoetes lacustris*, *Litorella uniflora* and *Myriophyllum alterniflorum*. Majority of these lakes are located in North Europe, from the British Isles, through Scandinavia to Finland. In Poland typical *Lobelia*-type lakes are present in Pomeranian Lakeland where they occupy the middle part of the terminal moraine and the suthward outwash plaines. *Lobelia*-type lakes are grouped in a few aggregations; one of them is located near Bytów.

Little atention has been paid to *Lobelia*-type lakes in the Polish literature. Fundamental works by Z. SZMAL (1959) and Z. SZMAL & B. SZMAL (1965) are still of primary importance. A little more interest in these lakes has been evoked in the recent years (KORDYLAS 1990, 1992, KRASKA (ed) 1994a, 1994b).

No studies on *Hydracarina* fauna in *Lobelia*-type lakes have ever been carried out in Poland or other countries. The objective of this work was to discuss the results of studies on *Hydracarina* fauna in three *Lobelia*-type lakes near Bytów and to make an attempt to define the specificity of *Hydracarina* fauna in these water bodies.

STUDY AREA.

The lakes under study (Fig. 1) are found in Bytów Lake District which constitutes north-east part of West Pomeranian Lakeland. This district is located in a marginal zone of the Pomeranian phase of the last glaciation which delineated the lobe of the Oder Glacier. Well developed moraine hills are a characteristic element of the landscape; their height exceeds 250 m above sea level (KONDRACKI 1978). Lobelia-type lakes are fairly numerous in the hydrographic net. They are usually rather small. Three lakes were

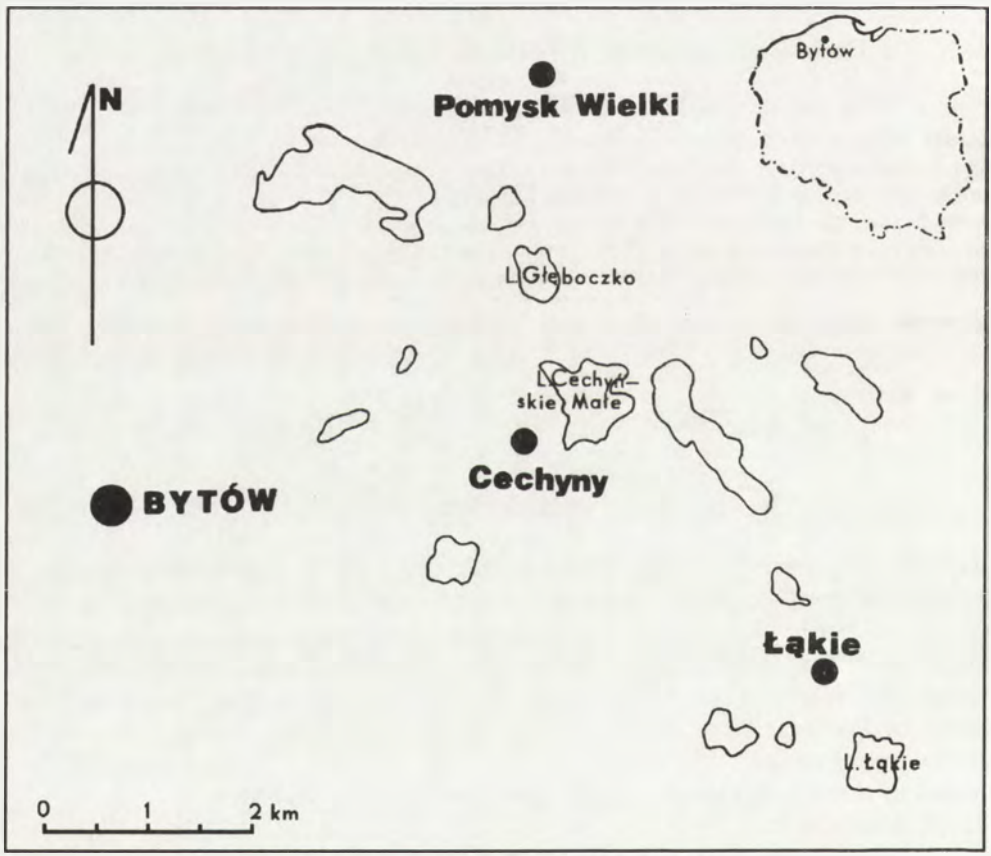

Fig. 1. Localization of investigated lakes

surveyed: Łąkie, Głęboczko and Cechyńskie Małe. Characteristics of these lakes are given in Table I.

Lake Łąkie. Located near the village Łąkie, 8 km east of Bytów. Half of the lake is surrounded with forest, the other half with arable and waste land. Lake shape resembles a square; the shore line is weakly developed. Bottom of a shallow littoral is sandy or covered with gravel and stones. A *Sphagnum* peat bog is located at the south-west shore, and the lake bottom is peaty there too. Communities of *Carex* sp., *Heleocharis* sp. and *Juncus* sp. are well developed in the shallow littoral. Indicatory plants, i.e. *Lobelia dortmanna* and *Isoetes lacustris*, are abundant only in the north and north-east part of the lake. According to Z. SZMAL (1959) Lake Łąkie can be classified as „deeply dystrophic" in STANGENBERG'S (1936) classification, this being due to low content and acidic pH in the hypolimnion.

Lake Głęboczko. Located near the village Pomysk Wielki, about 5 km north-east of Bytów. The lake is almost totally surrounded by forested hills; only the north part adjoins some waste lands and a single house. Bottom of the upper littoral is generally sandy; it is muddy only in the north-east part. There are well developed communities of *Juncus* sp. and *Heleocharis* sp., and sedge belts in the shallowest littoral. Indicatory plants: *Lobelia dortmanna*, *Isoetes lacustris* and *Litorella uniflora* are very abundant. *Lobelia dortmanna* is present already at the depth of about 0.2 m, and in shallow water it is frequently mixed with *Heleocharis* sp. communities. From the depth of some 0.8 m there is a large belt of *Myriophyllum alterniflorum*. According to Z. SZMAL (1959) Lake Głęboczko can be classified as α-mesotrophic.

Lake Cechyńskie Małe. Located near the village Cechyny, 5 km east of Bytów. The lake is situated in a moraine landscape, surrounded with deciduous forest. Only the south-west shore is surrounded with meadows, waste lands and houses of Cechyny village. The shore line is well developed. The upper littoral bottom is usually sandy. Sedge communities are well developed, *Juncus* sp. and *Heleocharis* sp. less so. Plants indicatory for *Lobelia*-type lakes are very numerous. According to Z. SZMAL (1959) Lake Cechyńskie Małe can be classified as β-mesotrophic.

Table I. Morphometrical and chemical characteristics of investigated lakes after *CHOIŃSKI (1991), **KRASKA, SZYPER, ROMANOWICZ (1994)

Lake	Surface area* [ha]	Depth** [m]	Visibility** [m]	Catch-ment area** [ha]	pH**	Ca** [mg/dm^3]	P total.** [mg/dm^3]	N total.** [mg/dm^3]
Łąkie	22.5	22.6	5.1	77.6	5.7-6.6	6.5-7.9	0.010-0.033	0.80-1.10
Głęboczko	20.5	25.8	4.1	163.6	7.0-7.1	4.1-4.3	0.030-0.068	1.30-1.60
Cechyńskie Małe	47.5	17.5	3.5	329.1	7.0-7.2	11.5-12.2	0.045-0.049	1.40-1.55

MATERIALS AND METHODS

Field surveys were carried out in 1991–1992 during three expeditions, each lasting a few days. Sampling stations were selected in each lake with attention paid to habitat diversity. Nine major habitats were distinguished for further analyses: habitat consisting of a bare sandy, gravel or stony bottom (depth to 0.5 m), habitat of muddy bottom not overgrown with plants (depth to 0.8 m), sedge belts of the upper littoral (depth to 0.4 m), communities of *Juncus* sp. and *Heleocharis* sp. (depth to 0.2 m), communities of *Lobelia dortmanna* (depth 0.5–1 m), communities of *Myriophyllum alterniflorum* (depth 0.5–1.5 m), depth zones of 1–3 m, 3–5 m and over 5 m.

A hydrobiological sampler was used to collect samples in the shallow littoral, while in deeper waters a dredge was used from a boat. Totally about 120 samples were collected. *Hydracarina* were present in 107 samples, of which 43 from Lake Łąkie, 28 from Lake Głęboczko and 36 from Lake Cechyńskie Małe. The collected material comprised 3809 *Hydracarina* individuals. Taking into account the distribution of the sampling stations, habitat diversity, method of material collection and sampling dates, the collected material can be defined as representative.

To assess faunistic similarity between the analysed habitats, Renkonen's number was used (after TROJAN 1978):

$$Re = \sum D_{min}$$

where: D_{min} – the smallest value of the coefficient of individual domination of the species in compared habitats.

RESULTS

General characteristics of *Hydracarina* in the lakes.

The collected material contained 63 *Hydracarina* species (Table II).*Arrenurus neumani* was the most numerous species (46.4% of imagines), followed by *Hydrodroma despiciens* and *Limnesia maculata* (10.74% each), *Unionicola crassipes* (8.26%), *Brachypoda versicolor* (6.48%), *Mideopsis orbicularis* (4.6%) and *Arrenurus compactus* (4.36%). Totally 15 species were present in higher numbers than 50 specimens, 20 species were within the range of 6–50 imagines, and 28 species were represented by 5 individuals each.

Table II. Quantitative comparison of water mites (*Hydracarina*) in the lobelian lakes; dny – deutonymphs. N – number of specimens

Species	Lakes						In three lakes total	
	Łąkie		Głęboczko		Cechyńskie Małe			
	N	%	N	%	N	%	N	%
1	2	3	4	5	6	7	8	9
Hydrachna globosa (GEER)	4	0.31	-	-	-	-	4	0.13
Limnochares aquatica (L.)	2	0.15	2	0.44	1	0.07	5	0.16
Eylais muelleri KOEN.	1	0.08	-	-	-	-	1	0.03
Eylais relicta HALB.	-	-	-	-	3	0.21	3	0.09
Eylais setosa KOEN.	-	-	-	-	1	0.07	1	0.03
Eylais undulosa KOEN.	1	0.08	-	-	2	0.14	3	0.09
Hydrodroma despiciens (MÜLL.)	24	1.84	15	3.30	304	21.17	343	10.74
Lebertia saxonica THOR	38	2.91	-	-	-	-	38	1.19
Oxus angustipositus VIETS	-	-	-	-	1	0.07	1	0.03
Oxus *ovalis* (MÜLL.)	-	-	-	-	11	0.77	11	0.34
Frontipoda musculus (MÜLL.)	-	-	26	5.71	49	3.41	75	2.35
Limnesia connata KOEN.	1	0.08	-	-	1	0.07	2	0.06
Limnesia maculata (MÜLL.)	3	0.23	111	24.40	229	15.95	343	10.74
Limnesia polonica SCHECHT.	-	-	5	1.10	19	1.32	24	0.75
Limnesia undulata (MÜLL.)	1	0.08	3	0.66	3	0.21	7	0.22
Hygrobates longipalpis (HERM.)	3	0.23	10	2.20	41	2.86	54	1.69
Atractides lacustris (LUNDBL.)	-	-	1	0.22	1	0.07	2	0.06
Unionicola crassipes (MÜLL.)	14	1.07	92	20.22	158	11.00	264	8.26
Unionicola gracilipalpis (VIETS)	23	1.76	13	2.86	4	0.29	40	1.25
Unionicola minor (SOAR)	3	0.23	2	0.44	2	0.14	7	0.22
Neumania callosa (KOEN.)	-	-	6	1.32	1	0.07	7	0.22
Neumania deltoides (PIERS.)	-	-	-	-	11	0.77	11	0.34
Neumania spinipes (MÜLL.)	-	-	-	-	7	0.49	7	0.22
Neumania vernalis (MÜLL.)	1	0.08	17	3.74	17	1.18	35	1.10
Huitfeldtia rectipes THOR	-	-	2	0.44	-	-	2	0.06
Forelia brevipes (NEUM.)	2	0.15	-	-	-	-	2	0.06
Forelia liliacea (MÜLL.)	80	6.13	-	-	3	0.21	83	2.60
Forelia spatulifera (MARUCCI)	-	-	-	-	2	0.14	2	0.06
Forelia variegator (KOCH)	-	-	-	-	8	0.56	8	0.25
Piona alpicola (NEUM.)	-	-	1	0.22	2	0.14	3	0.09
Piona coccinea (KOCH)	-	-	9	1.98	13	0.91	22	0.69
Piona conglobata (KOCH)	10	0.77	-	-	40	2.79	50	1.56
Piona dispersa SOKOL.	2	0.15	-	-	-	-	2	0.06
Piona longipalpis (KREND.)	2	0.15	10	2..20	12	0.84	24	0.75
Piona obturbans (PIERS.)	1	0.08	-	-	-	-	1	0.03
Piona paucipora (THOR)	-	-	1	0.22	10	0.70	11	0.34
Piona pusilla (NEUM.)	35	2.68	5	1.10	4	0.29	44	1.38
Piona rotundoides (THOR)	-	-	1	0.22	1	0.07	2	0.06
Piona stjoerdalensis (THOR)	-	-	-	-	108	7.52	108	3.38
Piona variabilis (KOCH)	14	1.07	22	4.84	7	0.49	43	1.35
Hydrochoreutes krameri PIERS.	11	0.84	25	5.49	74	5.15	110	3.44
Tiphys ensifer (KOEN.)	-	-	1	0.22	-	-	1	0.03
Pionopsis lutescens (HERM.)	76	5.83	8	1.76	1	0.07	85	2.66
Pionacercus uncinatus (KOEN.)	-	-	1	0.22	-	-	1	0.03
Brachypoda versicolor (MÜLL.)	16	1.23	10	2.20	181	12.60	207	6.48
Mideopsis orbicularis (MÜLL.)	84	6.44	14	3.08	49	3.31	147	4.60
Midea orbiculata (MÜLL.)	-	-	-	-	2	0.14	2	0.06

1	2	3	4	5	6	7	8	9
Arrenurus affinis KOEN.	2	0.15	-	-	-	-	2	0.06
Arrenurus albator (MÜLL.)	6	0.46	10	2..20	37	1.58	53	1.66
Arrenurus bicuspidator BERL.	1	0.08	4	0.88	2	0.14	7	0.22
Arrenurus bifidicodulus PIERS.	3	0.23	-	-	-	-	3	0.09
Arrenurus claviger KOEN.	1	0.08	-	-	2	0.14	3	0.09
Arrenurus compactus PIERS.	140	10.74	-	-	-	-	140	4.38
Arrenurus forpicatus NEUM.	-	-	1	0.22	-	-	1	0.03
Arrenurus globator (MÜLL.)	83	6.34	1	0.22	5	0.35	89	2.79
Arrenurus neumani PIERS.	605	46.40	10	2.20	-	-	615	19.25
Arrenurus nobilis NEUM.	1	0.08	-	-	-	-	1	0.03
Arrenurus pustulator (MÜLL.)	4	0.31	-	-	-	-	4	0.13
Arrenurus robustus KOEN.	1	0.08	1	0.22	-	-	2	0.06
Arrenurus stjoerdalensis THOR	2	0.15	10	2.20	3	0.21	15	0.47
Arrenurus tricuspidator (MÜLL.)	-	-	5	1.10	4	0.29	9	0.28
Arrenurus tubulator (MÜLL.)	1	0.08	-	-	-	-	1	0.03
Arrenurus vietsi KOEN.	2	0.15	-	–	-	-	2	0.06
Imagines total	1304		455		1436		3195	
Hydracarina dny	272		124		217		614	
Imagines + dny total	1576		580		1653		3809	

It should be underlined that species composition of *Hydracarina* in the three lakes comprised 9 acidophilic species connected with dystrophic waters. These were: *Limnochares aquatica, Neumania spinipes, Piona alpicola, Arrenurus affinis, A. compactus, A. forpicatus*, A. *neumani, A. pustulator* and *A. robustus*. Six species can be defined as indicatory for oligo-mesotrophy: *Atractides lacustris, Neumania callosa, Huitfeldtia rectipes, Piona paucipora, Arrenurus nobilis* and *A. stjoerdalensis*. There were 11 species characteristic of moderate trophy. The other species belonged to a large class of *Hydracarina* which inhabit small water bodies and are eurytopic.

Special attention should be given to the presence of species new for Poland: *Eylais relicta, Lebertia saxonica* and *Arrenurus vietsi*. *Eylais relicta* is known from some stations (oligotrophic or poor eutrophic lakes and ponds) in northern Europe. *Lebertia saxonica* and *Arrenurus vietsi* are the rare species of european distribution. A few species (*Atractides lacustris, Neumania callosa, Huitfeldtia rectipes, Pionacercus uncinatus, Arrenurus compactus, A. nobilis, A. stjoerdalensis*) are fairly rare in Poland.

Due to considerable individualisation of *Hydracarina* fauna in particular lakes, it does not seem justified to discuss them as a whole.

Characteristics of Hydracarina in particular lakes

Lake Łąkie

40 species were distinguished in the collected material (Table II), with *Arrenurus neumani* being the most numerous (46.4% of imagines). This species is especially characteristic for the lake in question; 98% of its total numbers in the whole material were found in Lake Łąkie. The second position

was represented by *Arrenurus compactus*, followed by *Mideopsis orbicularis*, *Arrenurus globator*, *Forelia liliacea* and *Pionopsis lutescens*. As many 13 species were present exclusively in Lake Łąkie. They comprised relatively numerous species such as *Arrenurus compactus* and *Lebertia saxonica*.

Arrenuridae family was characterized by the highest numbers (62.25% of imagines), followed by *Pionidae* (17.87%). Six species could have been classified as acidophilic *Hydracarina* (indicators of dystrophy). Their total numbers reached 58% of all colected imagines. Ten species were specific lake indicators, in this three (*Arrenurus stjoerdalensis*, *A. nobilis*, *Piona paucipora*) were the indicators of oligo-mesotrophy, and other seven – of moderate eutrophy. Total numbers of species regarded as indicators of oligo-mesotrophy represented 0.23% of the material, while those of moderate eutrophy – 11%. Eurytopic species and those characteristic of small water bodies were of secondary importance in the *Hydracarina* fauna of Lake Łąkie (Fig. 2).

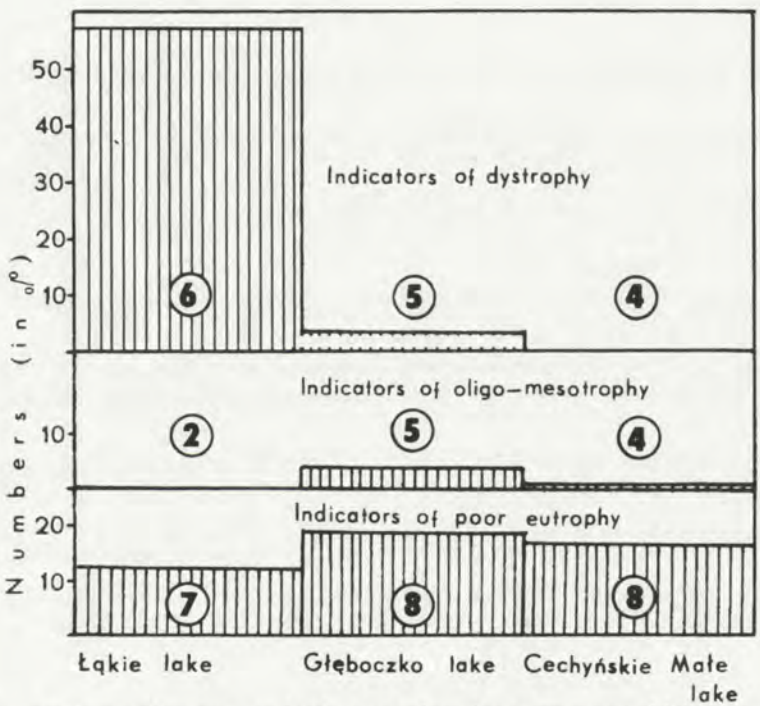

Fig. 2. The structure of the groups of indicators of trophy in investigated lakes (in the ring is designated a number of the species)

Lake Głęboczko

Noticeably less *Hydracarina* were collected in this lake than in the others. Species diversity of this small material was also lower (35 species) than in Lake Łąkie. Eurytopic species *Limnesia maculata* was the most numerous one

(24.4% of imagines) followed by *Unionicola crassipes*, *Frontipoda musculus*, *Hydrochoreutes krameri* and *Piona variabilis*. There were 4 species which occurred only in this lake, two other species were also present in Lake Łąkie, and there were 9 species common with Lake Cechyńskie Małe, while 20 species occurrred in all three lakes.

The family *Unionicolidae* was the most numerous (28.57% of imagines), followed by *Limnesiidae* (26.15%) and *Arrenuridae* (8.57%).

As regards the species composition, majority of the species were the indicators of moderate eutrophy (8 species, 17.58% of the numbers of imagines). Five species were indicatory of oligo-mesotrophy (4.39% of the numbers). *Hydracarina* of dystrophic waters were represented by five species, the total numbers of which reached 3.29% of all collected imagines. In the *Hydracarina* fauna of Lake Głęboczko the eurytopic species and those typical of small water bodies were the most important; they constituted almost 75% of the numbers of all the materials (Fig. 2).

Lake Cechyńskie Małe

The most numerous and the most diversified materials were collected in this lake. As many as 44 species were distinguished, of which the following were the most numerous: *Hydrodroma despiciens*, *Limnesia maculata*, *Brachypoda versicolor*, *Unionicola crassipes* and *Piona stjoerdalensis*. Ten species occurred only in this lake. They comprised a relatively numerous species *Piona stjoerdalensis* which is common in eutrophic lakes.

Quantitative composition of the families was also different than in other lakes. The most numerous *Hydracarina* were those belonging to the family *Hydrodromidae* (21.17% of the imagines), followed by *Pionidae* (19.85%), *Limnesidae* (17.55%), *Unionicolidae* (13.94%) and *Aturidae* (12.6%).

Within the distinguished system of indicatory species the most important were those characteristic of moderate eutrophy. Eight species were distinguished in this group and their total numbers reached 15.74% of the total number of imagines. Indicators of oligotrophy were much less numerous (4 species, 1.05% of imagines). Indicators of dystrophy were of a totally marginal character (4 species, 0.76% of the numbers). Similarly as in Lake Głęboczko, species of small water bodies and eurytopic were most numerous. This species are 83% of all materials collected in this lake (Fig. 2).

Environmental distribution of Hydracarina

Due to the fact that samples were collected in uniform habitats and at stations which were most typical for the investigated lakes, it is possible to give the characteristics of *Hydracarina* distribution at particular stations.

The most numerous samples were generally collected from sedge beds (22.34% of the entire material), *Lobelia dortmanna* communities (19.27%) and the communities of *Juncus* sp. and *Heleocharis* sp. (15.46%). *Hydracarina* numbers in other habitats were as follows: 1–3 m depth zone – 9.92% of the

numbers, *Myriophyllum alterniflorum* community – 9.14%, 3–5 m depth zone – 7.04%, below 5 m depth – 7.4%, bare sandy, gravel or stony bottom – 4.67%, muddy bottom – 0.39%. Less than 5% of the collected material originated from all other habitats of a mixed character. These data suggest that *Hydracarina* are attracted most of all by sedge beds, communities of *Lobelia dortmanna*, *Juncus* sp. and *Heleocharis* sp., depth zone of 1–3 m, and *Myriophyllum alterniflorum* community. This generalisation, however, appears little justified when analysis is carried out of *Hydracarina* distribution in particular habitats of each lake separately (Fig. 3).

In Lake Łąkie the fauna Hydracariana was concentrated most of all in sedge beds of the shallowest littoral and in the communities of *Juncus* sp. and *Heleocharis* sp., and of *Lobelia dortmanna*. High numbers of *Hydracarina* in these habitats were due to the presence of *Arrenurus neumani* and *A. compactus*. These two species represented 54.66% of all imagines collected from sedge beds, 80.87% of those collected from *Juncus* sp. and *Heleocharis* sp. community, and 76.21% of those from *Lobelia dortmanna* community. The highest numbers of species were obserwed in sedge belts and community of *Juncus* sp. and *Heleocharis* sp.

Sedge communities were well developed also in other lakes but nowhere else they were as important for the *Hydracarina* fauna as in Lake Łąkie. The same refers to the communities of *Juncus* sp. and *Heleocharis* sp. which were well developed in all lakes, and especially in Lake Głęboczko. Occurrence of *Hydracarina* in *Lobelia dortmanna* community was very interesting. This community occupied the largest area in Lake Głęboczko and the smallest one in Lake Łąkie. Notwithstanding this, this community was of secondary importance for the *Hydracarina* fauna in Lake Głęboczko, but or primary importance in Lake Cechyńskie Małe, where it yielded the highest number of *Hydracarina* although only two species, *Hydrodroma despiciens* and *Brachypoda versicolor*, were responsible for these high numbers. These two species were most numerous in *Lobelia dortmanna* community.

Myriophyllum alterniflorum community was fairly important for the occurrence of *Hydracarina* in Lake Cechyńskie Małe; 16.75% of the materials were collected from this community. *Myriophyllum alterniflorum* community was best developed in Lake Głęboczko where it extended as a compact belt to the depth of 0.5–1.5 m. This, however, was not reflected in rich *Hydracarina* fauna collected from this lake – only 12.24% of the entire material originated from this community.

Hydracarina were present in all depth zones. In Lake Łąkie their numbers increased noticeably at the depth of 3–5 m, in the other lakes at the depth of 1–3 m. This was especially noticeable in Lake Głęboczko, in which majority of *Hydracarina* were collected in the lower littoral, beyond the vegetation zone.

Analysis of similarity between the distinguished habitats was performed for each lake (Fig. 3). In each lake different groups of habitats were obtained. A group composed of three habitats in Lake Łąkie stood apart most strongly; it

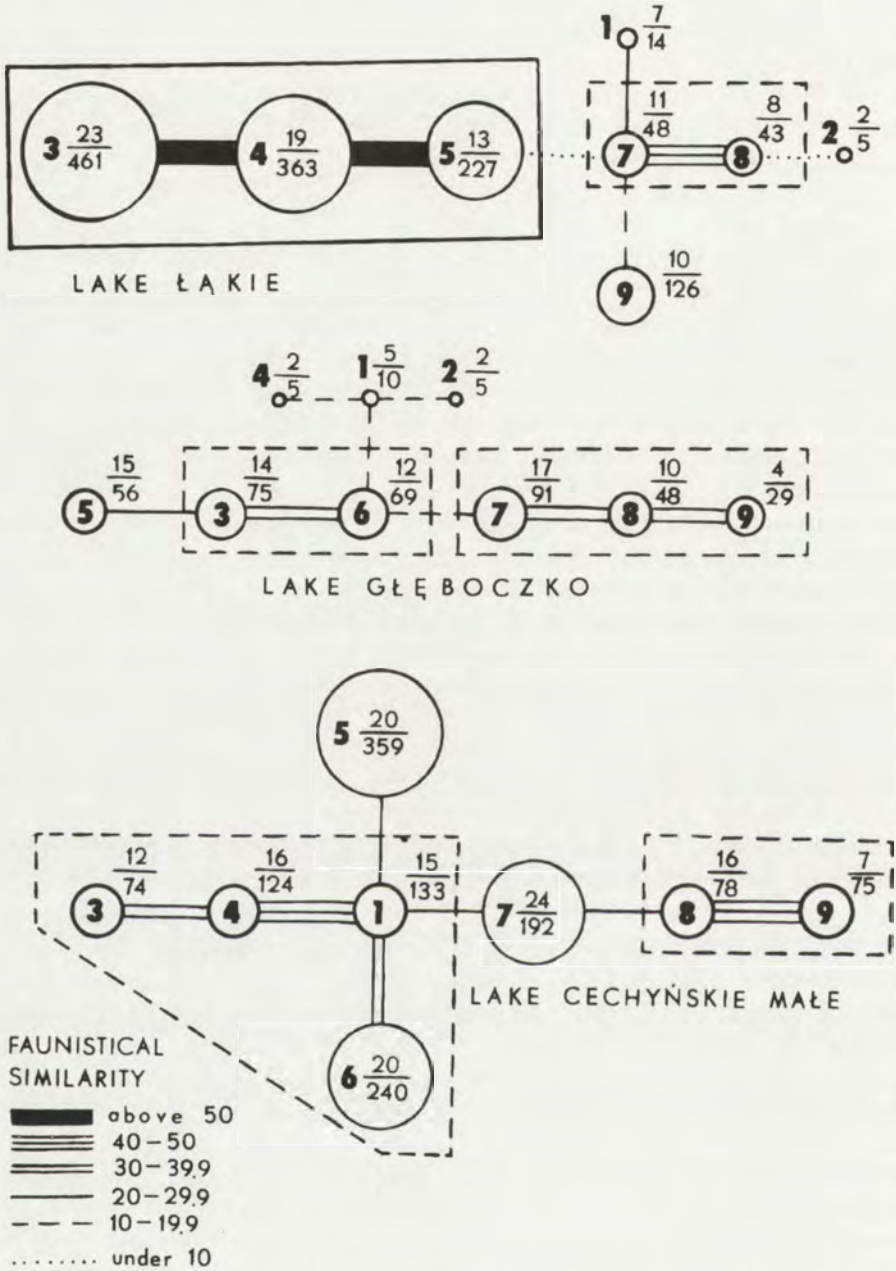

Fig. 3. Diagram of faunistical similarity between habitats of the investigated lakes (1 – bare sandy, gravel or stony bottom, 2 – muddy bottom, 3 – sedge beds, 4 – communities of *Juncus* sp., *Heleocharis* sp., 5 – *Lobelia dortmanna* communities, 6 – *Myriophyllum alterniflorum* communities, 7 – 1–3 m depth zone, 8 – 3–5 m depth zone, 9 – below 5 m depth; the share of the ring is a equivalent to the numbers of water mites, number above the line is a number of the species, number below there is a number of specimens water mites

comprised sedge belts of the shallowest littoral, *Juncus* sp. and *Heleocharis* sp. community, and *Lobelia dortmanna* community.

DISCUSSION

The fauna of *Hydracarina* in Polish lakes is fairly well known and it might seem that *Lobelia*-type lakes would not yield many new facts but only a little complementary knowledge. The fauna of *Lobelia*-type lakes is characterised by a co-existance of two elements: *Hydracarina* species defined as the indicators of oligo- and mesotrophy, and acidophilic ones, which are the indicators of dystrophy. In addition to this, *Hydracarina* indicators of weak eutrophy were relatively numerous in all lakes under study. Acidophilic fauna was connected with the upper littoral. *Hydracarina* characteristic of weakly eutrophic lakes inhabited deeper layers, mostly the sublittoral and profundal zones. Presence of a specific cold stenothermic *Hydracarina* in the profundal zone reflects considerable ecological stability of the lakes under study, all of which were rather small.

The other faunistic element of special importance in *Lobelia*-type lakes viz. the acidophilic species were characterised by highly variable numbers. In Lake Łąkie these species were the dominating component in the littoral, while in Lake Cechyńskie Małe their numbers were very low. It can be assumed that numbers of these species are not stable and may vary from year to year. This is also suggested by the fact that their larvae are the parasites of flying insects, mostly of *Odonata* and *Diptera*.

Numbers of *Hydracarina* characteristic of small water bodies were also very variable. Their share was the highest in Lake Cechyńskie Małe, the lowest in Lake Łąkie. According to BIESIADKA and KOWALIK (1991) share of this element in *Hydracarina* numbers can be regarded as a measure of eutrophy. Hence, Lake Cechyńskie Małe would be clearly developing in the direction of eutrophy, while Lake Łąkie in the direction of dystrophy (acidotrophy). In Lake Głęboczko there was still no clear developmental determinism. This lake represented the most primary type, as reflected also in the highest numbers of indicators of oligo- and mesotrophy, as well as of weak eutrophy. Obviously these results should be treated as preliminary ones and must be verified on a higher number of more diversified *Lobelia*-type lakes.

Hydracarina were studied in Mazurian Lakeland in two lakes with *Isoetes lacustris* (CICHOCKA, BIESIADKA 1994). Low calcium content in these lakes enables their classification as close to *Lobelia*-type lakes. These lakes were, however, quite different with respect to their fauna. Lake Tyrsko had fauna typical of mesotrophic lakes, whereas Lake Czarne represented faunistic type of a dystrophic lake. Comparison of *Hydracarina* fauna in Mazurian lakes with Isoetes lacustris and *Lobelia*-type lakes of Pomerania revealed that regional factors were quite important in determining this fauna. This was especially true of the littoral zone. *Lobelia*-type lakes of Pomeranian Lakeland

constitute a large lake complex, and this favours their specific faunistic character compared to other lakes. The discussed Mazurian lakes with *Isoetes lacustris* are unique in this region. There is no possibility in these lakes to maintain characters that would differ from a typical faunistic standard of a mesotrophic or a dystrophic lake.

Surveys of *Lobelia*-type lakes yielded many interesting facts and knowledge on early evolution of lakes with low calcium content in water. It is obvious that in relation to lakes with high calcium content these lakes are characterised by higher stability. They also retain more primitive faunistic character. Surveys of a higher number of more diversified *Lobelia*-type lakes would enable formulation of more precise and more final conclusions.

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STRESZCZENIE

[Tytuł: Fauna wodopójek (*Hydracarina*) jezior lobeliowych okolic Bytowa.]

Badania terenowe prowadzono w latach 1991–1992. Objęto nimi trzy jeziora lobeliowe: jezioro Łąkie, jezioro Głęboczko i Jezioro Cechyńskie Małe.

W zebranym materiale obejmującym 3195 dorosłych wodopójek i 614 deutonimf wyróżniono 63 gatunki. W jeziorze Łąkie stwierdzono 40 gatunków o łącznej liczebności 1304 osobniki (Tab. II). Najliczniejszym gatunkiem był *Arrenurus neumani* (46,4% zebranych wodopójek). Jezioro to charakteryzuje się wysoką liczebnością gatunków acydofilnych (58%), niską liczebnością wskaźników oligo–mezotrofii i stosunkowo wysoką liczebnością wskaźników umiarkowanej eutrofii (Ryc.2).W jeziorze Głęboczko fauna *Hydracarina* była uboższa (35 gatunków o łącznej liczebności 455). Najliczniejszym gatunkiem była *Limnesia maculata*. Największą rolę ilościową odgrywały tu gatunki eurytopowe, drobnozbiornikowe (75% liczebności). Stosunkowo wysoka była liczebność gatunków– wskaźników umiarkowanej eutrofii. (17,58%) (Ryc.2). W Jeziorze Cechyńskim Małym, w materiale obejmującym 1436 osobników, wyróżniono 44 gatunki. Szczególnie wysoka była tu liczebność gatunków drobnozbiornikowych o dużej eurytopowości (83%). W strukturze gatunków wskaźnikowych dominowały wskaźniki umiarkowanej trofii (15,7%).

Najwięcej wodopójek zebrano w turzycowiskach, zbiorowiskach *Lobelia* i *Heleocharis*. W jeziorze Łąkie zaobserwowano wzrost liczebności na głębokości 3–5 m, a w pozostałych na głębokości 1–3 m. Zróżnicowanie fauny wodopójek badanych jezior, biorąc pod uwagę udział gatunków acydofilnych i elementu drobnozbiornikowego sugeruje rozwój jeziora Łąkie w kierunku dystrofii, a Jeziora Cechyńskiego Małego w kierunku eutrofii. Natomiast jezioro Głęboczko reprezentuje najbardziej pierwotny typ o czym świadczy najwyższa liczebność wskaźników oligo-mezotrofii i słabej eutrofii.

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