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Water mites (Hydracarina) of three small lakes in the neighbourhood of Poznań

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Abstract - The dependence of the water mite fauna on the type of vegetation was shown in three eutrophic lakes. Two types of lake were distinguished in connection with the degree of formation of astatic zones. The occurrence of water mites in the annual cycle was analysed.

Key words: water mites, eutrophication, lake species, small body species, species of astatic zones.

1. Introduction

Investigations on the occurrence and ecology of lake water mites have in Poland a fairly long tradition. Those started by Zacharias (1887) and Viets (1924) were taken up by Tutaj (1936) - Lake Kierskie, by Pieczyński (1959, 1960a,b, 1963, 1964, 1967, 1976) - the Mazurian lakes, by Biesiadka (1972a,b, 1977) - Lake Kierskie, the Konin lakes and lakes of the Great Poland National Park, by Kowalik (1973, 1977, 1978) - Łęczyńsko-Włodawskie Lakes.

The aim of the present work was to present an analysis of the composition of species in Lakes Dębiniec, Brzostek, and Drążynek. An attempt was also made to distinguish and describe the grouping of water mites on the basis of their life environment and in particular of plant communities, while the usefulness of water mites was also investigated as an indicator of the biological condition of the water body. The occurrence of water mites in the annual cycle was analysed.

2. Study area

The investigated lakes are in the Gniezno Lake District (Kondracki 1988) in the neighbourhood of Poznań near Promno. They are small sylvan, postglacial pools.

Lake Brzostek is a eutrophic pool of 6 ha and 7.0 m maximum depth. The vegetation overgrowing its shores penetrates into the lake only slightly. The main plant communities are: *Phragmitetum communis*, *Caricetum ripariae*, *Potametum perfoliati*, and *Nupharo-Nymphaeetum* (a single-species form with *Nuphar luteum*). On the shores, there are: *Salicetum petandro-cinerea* and *Ribo nigri-Alnetum*. The bottom of the water body is covered with a thin layer of silt. At the shore there is a small sector of sandy beach.

Lake Dębiniec is eutrophic water body of 17 ha and a maximum depth of 8.5 m. The lake lies within a nature reserve. It shores are thickly overgrown with bulrushes. From the land side there is a narrow strip of *Caricetum acutiformis* passing into *Ribo nigri-Alnetum*. Here and there some patches of *Caricetum ripariae* occur. At a depth of 2-4 m stretches of *Charetum tomentose* appear, passing into very narrow *Nitelopsidetum obtusae*. Here also are *Nupharo-Nymphaeetum* (a single-species with *Nymphea alba*) and a short sector of sandy beach. The bottom of the lake is covered by a fairly thick layer of silt.

Lake Drążynek is a water body very strongly eutrophied, being 3/4 overgrown by bulrushes. Here *Phragmites communis* and *Cladium mariscus* prevail. The lake is very much silted and its maximum depth is 2 m. The water body is a nature reserve.

On the above-mentioned water bodies 29 stations were assigned: Stations 1-9 on Lake Brzostek, 10-22 on Dębiniec, and 23-29 on Drążynek (fig. 1). These stations were in different environments and were characterized by different limnological features. When setting up the stations, full differentiation of the environments of the investigated lakes were taken into account, special attention being paid to those in which water mites appear particularly numerously.

Thus, Stations 1, 8, 12, 14, 16, 18, and 23 were situated in patches of *Pragmitetum communis* at a depth of 0.2-1 m. Most of them were characterized by a thick layer of silt and by a volatilizing odour of hydrogen sulphide.

5, 6, 20, 25, and 28 were in patches of vegetation from the Caricetalia class (Stations 5, 6, 17, and 20 in *Caricetum ripariae*, and the remaining ones in *Caricetum acutiformis*),

4, 10 - in sandy littoral at a depth of not more than 1 m,

9, 11 - in silts near the sandy beach,

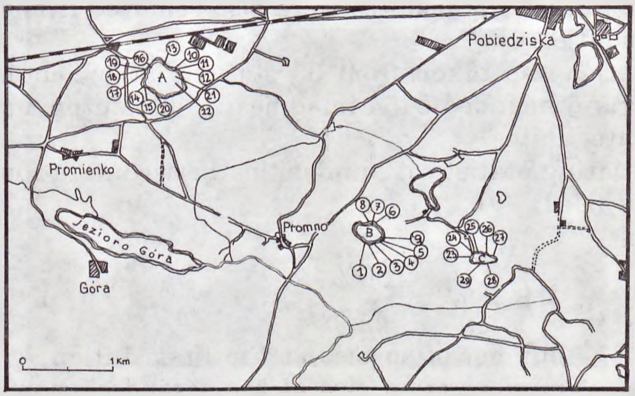

Fig. 1. Situational sketch of the investigated area: A - Lake Dębiniec; B - Lake Brzostek; C - Lake Drążynek; 1-29 - sampling stations

7, 29 - in patches of *Nupharo-Nymphaeetum* at a depth of 1-2 m,

2, 26 - in patches of *Salicetum petandro-cinerea* with a thick layer of silt and organic remains with a hydrogen sulphide odour, at a depth of about 0.2 m,

24, 27 - in patches of *Ceratophyletum demersi*, separated from the main surface film, at a depth of about 0.2 m with a thick layer of silt and odour of hydrogen sulphide,

3 - in a patch of *Potametum perfoliati*, at a depth of about 1.5 m,

15 - in silty littoral with organic remains and an odour of hydrogen sulphide at a depth of about 0.5 m,

19 - in water mosses in the patch of *Phragmitetum communis*,

21 - in a patch of *Charetum tomentosae*, at a depth of 2-3 m,

22 - in the profundal zone, at a depth of 3-7 m.

Besides the above-mentioned stations, water mites found in the cavities of mantles of the molluscs (*Anodonta anatina*) were treated as a separate station of their occurrence (Station 30).

3. Material and methods

The field investigations were carried out from April to November 1982. Single samples were additionally drawn in late April 1983.

The material was collected by quality methods. For collection in shallower places a sampler with a triangular hoop was used, but beyond the reach of its dredge. The principle of collecting all individuals from a sample was applied, which with the same number of collections with the sampler gave a certain orientation in

quantitative ratios. Water mites were also removed from the cavities of molusc mantles.

The material was taken from 30 stations at which 196 samples were drawn and included 3154 imagines, 1005 deutonymphs, and 18 larvae of water mites.

For calculating statistical similarities between stations Jaccard's formula was used:

$$S = \frac{W}{a + b - W} \quad 100\%$$

where:

a — number of species at the first station,
b — number of species at the second station,
W — number of common species.

4. Results

4.1. General characteristics of water mites

92 species of water mites were observed to occur. The material was very differentiated in respect of the number of individuals. The numbers of species ranged from 1-470 individuals (domination 0.03-23.48%). For ordering, this range was divided into the following classes of numbers: 1 individual, 2-5, 6-10, 11-50, 51-100, 101-200, 201-400, and more than 400 individuals. The statistical characteristics are presented in fig. 2. In general, statistical estimation of the collected material showed a strikingly great number of species with low numbers. From the total number of species 54 (57%) did not have more than 10 individuals.

Hydroroma despiciens was a distinctly dominant species, followed with regard to numbers being *Unionicola crassipes*, *Brachypoda versicolor*, *Arrenurus albator*, *A. globator*, and *A. inexploratus* (Table I).

Unionicola crassipes appeared to be the most common species followed by *Hydrodroma descipiens*, *Limnochares aquatica*, *Arrenurus globator*, *Hygrobates longipalpis*, *Mideopsis orbicularis*, and *A. albator* (Table I).

Hydrodroma despiciens followed by *Arrenurus globator*, *Brachypoda versicolor*, and *Limnochares aquatica* (Table I) had the highest frequency in the samples.

Two extremely rare species were found, i.e. *Hydrachna crassipalpis* 2 ♀♀ and *Arrenurus suecicus* 3 ♀♀ , a new species for Poland.

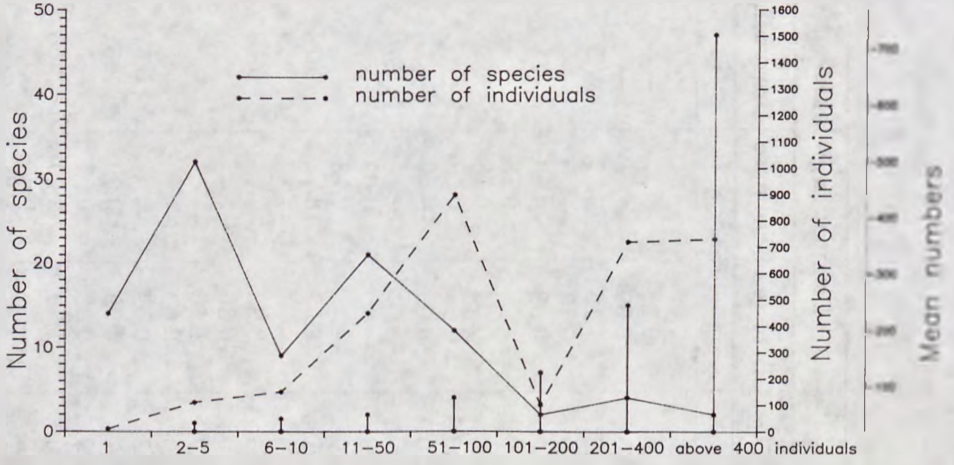

Fig. 2. Statistical specification of the collected material

4.2. Water mites on the background of the environment of their occurrence

In order to order the material, it is worthwhile to compare the statistical similarities between particular stations (fig. 3). In analysing the above-given scheme one can easily note three blocks. The largest included Stations: 1, 4, 6, 7, 9, 10, 14, 15, 16, and 18. Among these four were situated in a patch of *Phragmiteum*, two in the sandy littoral, two in silts, one in silty littoral, and one in a patch of *Caricetum*. The leading community of the block in this group of environments was *Pragmitetum communis*. The remaining environments directly adjoined it. Station 6, representing *Caricetum*, apart from that directly adjoining *Phragmitetum*, differed considerably from the remaining stations in patches of vegetation from the class of Caricetalia and approximated in its nature to the rarely overgrown *Phragmitetum*. The second block connected Stations 13, 17, 19, 20, and 25. Four of them were situated in patches of *Caricetum* and one of water mosses. The third, smallest, block comprised Stations 12, 21, and 22. They were found in patches of *Charetum tomentose*, *Phragmitetum communis*, and in the profundal zone. This picture was deformed by interrelations between the blocks and remaining stations, caused by a great number of eurytopic species at all stations. The block connected with *Phragmitetum communis* had the greatests number of such interrelations.

Table I. Quantitative specification of material

Species	Number of individuals	Domination	Frequency %		Domination in lakes		
			in samples	at stations	Brzostek	Dębiniec	Drążynek
a	b	c	d	e	f	g	h
Hydrachna cruenta Müll.	1	0.03	0.5	2.0	0.09	—	—
— *crassipalpis* Piers.	2	0.06	1.0	3.9	0.18	—	—
— *gallica* (Thor.)	1	0.03	0.5	2.0	0.09	—	—
Limnochares aquatica (L.)	84	2.70	18.4	41.2	1.16	2.57	7.97
Eylais discreta Koen.	2	0.06	1.0	3.9	0.18	—	—
Thyas barbigera Viets	2	0.06	1.0	3.9	0.09	0.09	—
— *dirempta* Koen.	2	0.06	1.0	3.9	—	0.18	—
— *pachystoma* Koen.	8	0.25	2.0	7.8	0.09	0.18	0.95
Hydryphantes ruber (Gerr)	1	0.03	0.5	2.0	—	0.09	—
— *affinis Sok.*	1	0.03	0.5	2.0	0.09	—	—
— *dispar* (Schaub)	1	0.03	0.5	2.0	—	—	0.19
— *placationis* Thon	1	0.03	0.5	2.0	—	0.09	—
— *thoni* Piers.	2	0.06	0.5	2.0	—	0.18	—
Hydrodroma despiciens (Müll.)	740	23.48	43.4	47.1	48.03	10.74	0.76
Oxus longisetus (Berlese)	1	0.03	0.5	2.0	—	—	0.19
— *ovalis* (Müll.)	37	1.17	5.1	7.8	3.23	—	0.19
— *strigatus* (Müll.)	4	0.13	0.5	2.0	0.36	—	—
— *angustipositus* Viets	13	0.41	1.5	2.0	1.16	—	—
Frontipoda musculus (Müll.)	1	0.03	0.5	2.0	0.09	—	—
Limnesia fulgida C. L. Koch	4	0.13	2.0	7.8	0.09	—	0.57
— *undulata* (Müll.)	31	0.98	4.6	15.7	0.99	0.09	3.61
— *polonica* Schechtel	2	0.06	1.0	3.9	0.09	0.09	—
— *maculata* (Müll.)	79	2.54	14.8	35.3	1.79	2.20	2.66
— *connata* Koen.	5	0.16	0.5	2.0	—	0.46	—
— *jaczewski* Bies.	2	0.06	1.0	3.9	—	0.09	0.19
Piersigia intermedia Will.	3	0.10	1.5	3.9	—	0.18	0.19
Hygrobates longipalpis (Herm.)	55	1.75	10.2	37.3	1.61	3.31	0.19
Atractides ovalis C. L. Koch	11	0.35	4.1	11.8	0.45	0.46	0.19

cont. Table I

a	b	c	d	e	f	g	h
Unionicola crassipes (Müll.)	233	7.93	16.8	51.0	2.96	10.38	20.30
— *minor Soar*	54	1.72	8.7	27.5	2.33	0.55	4.17
— *gracilipalpis* (Viets)	10	0.31	2.0	7.8	0.27	0.64	—
— *intermedia* (Koen.)	14	0.29	2.0	2.0	—	1.29	—
— *ypsilophora* (Bonz)	16	0.51	2.0	2.0	—	1.47	—
Neumania vernalis (Müll.)	4	0.13	1.5	3.9	0.36	—	—
— *spinipes* (Müll.)	8	0.25	2.6	7.8	0.18	—	1.12
— *limosa* (Koch)	4	0.13	1.0	3.9	—	0.09	0.57
— *deltoides* (Piers.)	1	0.03	0.5	2.0	—	—	0.19
Hydrochoreutes krameri Piers.	21	0.67	2.6	7.8	0.18	1.74	—
Tiphys bullatus (Thor.)	3	0.10	1.0	3.9	—	—	0.57
— *latipes* (Müll.)	18	0.57	1.0	3.9	—	1.65	—
— *ensifer* (Koen.)	26	0.83	2.6	7.8	—	2.20	0.38
Pionopsis lutescens (Herm.)	5	0.22	2.0	7.8	0.27	0.18	—
Pionacercus leuckarti Piers.	3	0.10	1.0	3.9	—	—	0.57
Piona carnea (Koch)	1	0.03	0.5	2.0	0.09	—	—
— *alpicola* (Neum.)	12	0.38	3.1	11.8	0.09	0.36	1.33
— *coccinea* (C. L. Koch)	3	0.10	1.5	3.9	—	0.18	0.19
— *longipalpis* (Krend.)	8	0.25	4.6	13.7	0.54	0.18	—
— *nodata* (Müll.)	89	2.54	4.6	13.7	0.63	7.53	0.19
— *obturbans* (Piers.)	1	0.03	0.5	2.0	—	—	0.19
— *pusilla* (Neum.)	8	0.25	2.0	7.8	—	0.09	1.33
— *rotundoides* (Thor.)	13	0.41	4.1	13.7	0.45	0.73	—
— *clavicornis* (Müll.)	4	0.13	0.5	2.0	—	—	0.76
— *conglobata* (C. L. Koch)	7	0.22	2.0	7.8	0.18	0.27	0.38
— *discrepans* (Koen.)	8	0.25	1.5	5.9	—	0.73	—
— *paucipora* (Thor.)	2	0.06	1.0	3.9	—	0.18	—
— *variabilis* (C. L. Koch)	10	0.29	4.6	13.7	0.18	0.64	0.19
Forelia liliacea (Müll.)	11	0.35	3.6	11.8	—	0.36	1.33
— *spatulifera* (Müll.)	29	0.95	6.1	9.8	—	2.38	—
— *variegator* (C. L. Koch)	1	0.03	0.5	2.0	—	0.09	—
Brachypoda versicolor (Müll.)	175	5.89	20.9	35.3	6.63	9.18	0.19

cont. Table I

a	b	c	d	e	f	g	h
Axonopsis complanata (Müll.)	4	0.13	1.5	3.9	—	0.36	—
Midea orbiculata (Müll.)	74	2.35	14.8	25.2	1.88	4.50	0.57
Mideopsis orbicularis (Müll.)	19	0.60	9.7	37.3	1.08	0.64	—
Arrenurus albator (Müll.)	107	3.39	15.3	37.3	2.96	2.20	0.57
— *batillifer* Koen.	1	0.03	0.5	2.0	—	—	0.19
— *bicuspidator* Berlese	1	0.03	0.5	2.0	—	—	0.19
— *tricuspidator* (Müll.)	2	0.06	0.5	2.0	—	—	0.19
— *bruzelli* Koen.	17	0.54	2.6	5.9	0.09	—	3.04
— *claviger* Koen.	74	2.38	11.7	25.5	2.06	4.59	0.19
— *crassicaudatus* Kramer	7	0.22	2.0	7.8	0.27	0.09	—
— *cuspidator* Koen.	62	1.97	10.2	21.6	4.12	0.18	2.09
— *fimbriatus* Koen.	43	1.94	6.1	9.8	0.09	—	7.97
— *maculator* (Müll.)	96	3.05	12.2	33.3	3.76	0.83	8.54
— *suecicus* Ldbl.	3	0.10	1.0	3.9	0.09	—	0.38
— *buccinator* (Müll.)	40	1.27	8.7	17.6	1.16	0.27	4.17
— *globator* (Müll.)	269	8.73	32.3	41.2	11.29	4.78	11.20
— *tubulator* (Müll.)	3	0.10	1.0	3.9	0.09	0.18	—
— *mediorotundatus* Thor.	1	0.03	0.5	2.0	0.09	—	—
— *muelleri* Koen.	2	0.06	1.0	3.9	—	—	0.38
— *securifromis* Piers.	5	0.16	1.0	3.9	—	0.46	—
— *knauthei* Koen.	5	0.16	1.5	5.8	—	0.36	0.19
— *nodosus* Koen.	4	0.13	1.5	3.9	—	0.27	0.19
— *stecki* Koen.	39	1.24	2.6	3.9	—	3.49	0.19
— *truncatellus* (Müll.)	27	0.98	5.6	13.7	0.09	0.83	1.51
— *bifidicodulus* Piers.	31	0.95	10.2	23.6	0.27	0.64	3.61
— *biscissus* Leb.	1	0.03	0.5	2.0	—	0.09	—
— *bisulcicodulus* Piers.	37	1.17	3.6	7.8	—	3.40	—
— *forpicatus* Neum.	1	0.03	0.5	2.0	—	—	0.19
— *inexploratus* Viets	115	3.65	7.7	17.6	0.09	8.45	3.98
— *integrator* (Müll.)	3	0.10	1.0	3.9	—	0.18	0.19
— *perforatus* George	11	0.35	2.0	7.8	—	1.01	—
— *sinuator* (Müll.)	22	0.70	4.1	7.8	0.45	1.29	—

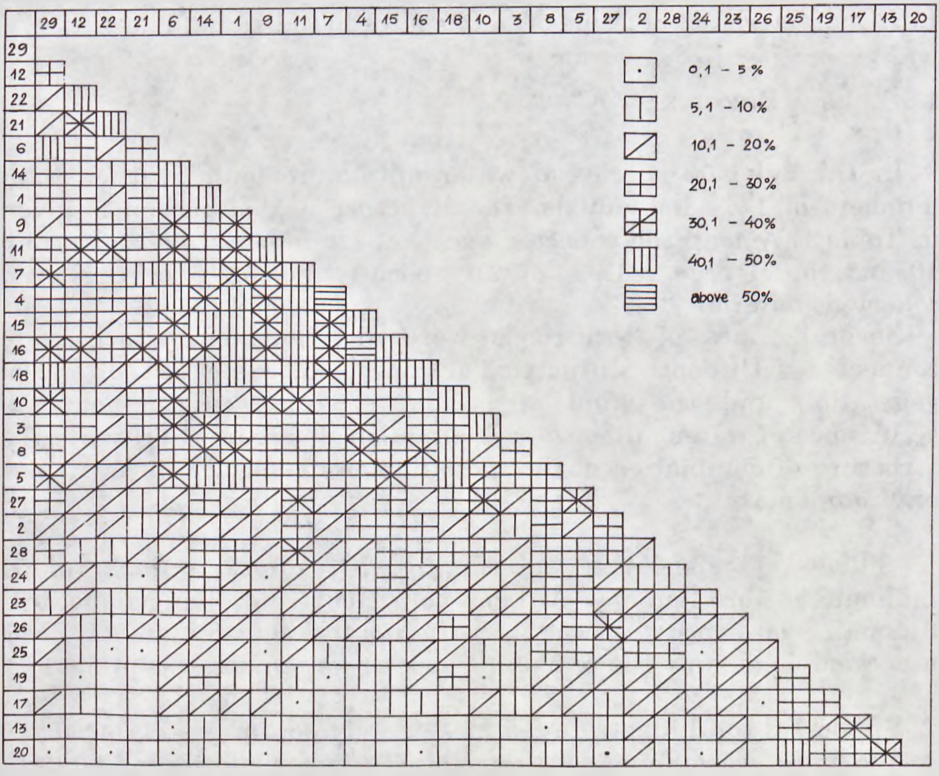

Fig. 3. Diagram of similarities between stations

Characteristic for the picture of the structure of similarities was a great separateness of stations from Lake Drążynek, which showed relatively little similarity to the remaining ones. At the same time, they showed no great similarities to each other, this resulting from the dissimilarity of this water body (a high degree of overgrowth and of eutrophication) and by the considerable isolation of particular stations, which prevented migration.

4.3. Characteristics of fauna of water mites in individual lakes

4.3.1. Lake Brzostek

In this lake 52 species of water mite were found with a total numbers of 1414 individuals. The structure of domination is given in Table I. Among the collected species 32 numbered no more than 10 individuals, i.e. 61.5% of all species and 5.9% of the total collected material.

Several zones of occurrence were distinguished, which were connected with depth. In particular zones, according to the type of vegetation and the kind of bottom separate environments of occurrence of water mites were distinquished. Figure 4 presents the structure of domination of the most numerous species in particular environments.

1. Silts — 11 species of water mite with a total number of 51 individuals were found. 5 of them were lacustrine, 3 eurytopic, and 3 small water body species. *Hydrodroma despiciens* (60.8%) was a decided dominant. The remaining species were much less numerous.

2. Shallow littoral (depth to 0.5 m) - Sandy bottom — 11 species of water mite were found with a total number of 67 individuals, including 6 lacustrine, 1 eurytopic, and 4 small water body species.

Caricetum — 31 species were observed with a total number of 405 individuals, including 11 lacustrine species, 6 eurytopic, and 9 small water body species and 3 characteristic for astatic waters.
Salicetum petandro-cinerea — 11 species were found with a total number of 16 individuals, 2 of them lacustrine, 4 eurytopic, and 3 small water body species, while 2 were astatic ones.

3. Deep littoral (depth 0.5-1.5m) - *Potametum perfoliati* — 22 species were observed with a total number of 282 individuals, including 10 lacustrine, 6 eurytopic, and 5 small water body species. *Phragmitetum communis* — 29 species were found with a total number of 264 individuals, including 7 lacustrine, 11 eurytopic, 8 small water body, and 3 astatic species.

4. Sublittoral (depth 1.5-2 m) - *Nupharo-Nymphaeetum* — 10 species were found with a total number of 87 individuals, including 7 lacustrine and 3 eurytopic species.

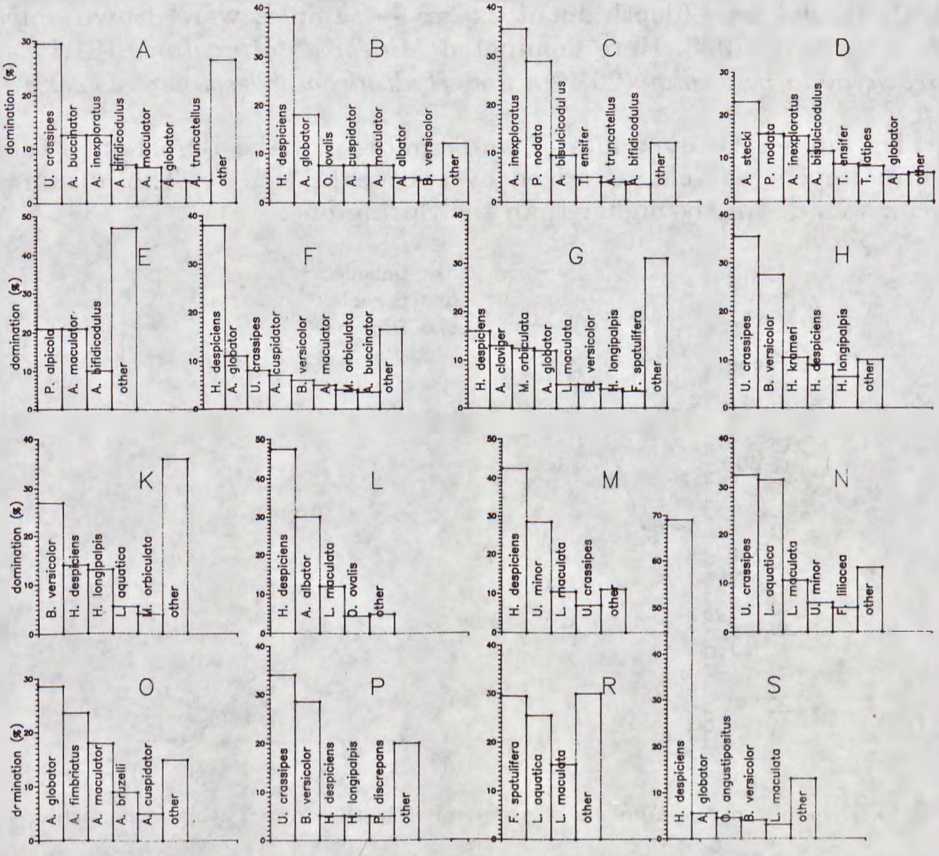

Fig. 4. The structure of numbers of water mites in particular environments: A - *Caricetum* of Lake Drążynek, B - *Caricetum* of Lake Brzostek, C - *Caricetum* of Lake Dębiniec, D - mosses, E - *Phragmitetum* of Lake Drążynek, F - *Phragmitetum* of Lake Brzostek, G - *Phragmitetum* of Lake Dębiniec, H - *Charetum tomentosae*, K - sandy littoral of Lake Brzostek, L - sandy littoral of Lake Dębiniec, M - *Nupharo Nymphaeetum* of Lake Brzostek, N - *Nupharo Nymphaeetum* of Lake Drążynek, O - *Ceratophylletum demersi*, P - profundal zone, R - silty littoral, S - *Potametum perfoliati*

5. Profundal zone (depth about 2.5 m) — samples were drawn only once in April 1983. Here dominated *Mideopsis orbicularis* (21.1%), *Brachypoda versicolor* (20.4%), and *Hydrodroma descipiens* (12.0%).

The numerical dynamics of water mites in Lake Brzostek in the annual cycle was characterized by two peaks (fig. 5). The autumn peak was distinctly higher than the Spring one.

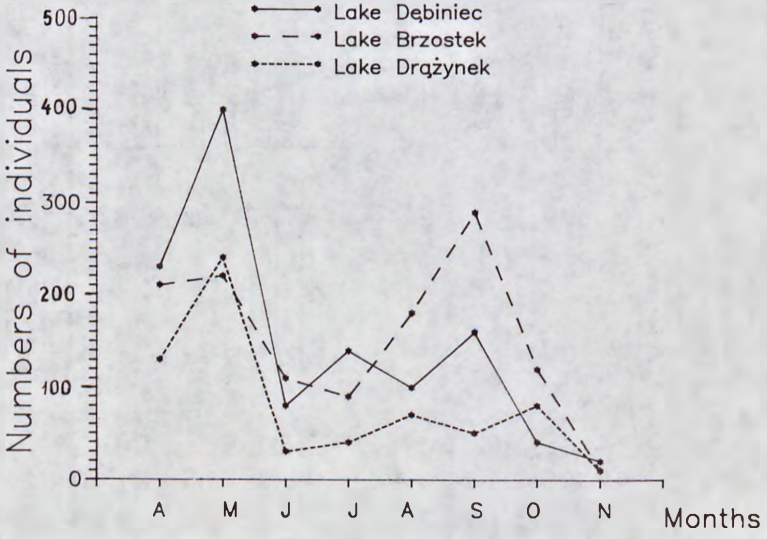

Fig. 5. Dynamics of the numbers of water mites in the annual cycle in particular lakes

4.3.2. Lake Drążynek

In this lake 53 species of water mite with a total number of 664 individuals were found (Table 1). Among the collected species 38 had numbers no higher than 10 individuals, i.e. 1.6% of all species and 17.5% of the total collected material.

Because of the considerable shallowing of the water it was impossible to distinguish typical zones of vertical distribution of water mites. According to the type of vegetation, the following environments of occurrence of water mites were distinguished (the structure of domination of species most numerous in particular zones is presented in fig. 4).

1. *Salicetum petandro-cinerea* — 16 species of water mite with a total number of 56 individuals were found. 5 of them were lacustrine

species and 8 were eurytopic. Most numerous were *Limnesia undulata* (32.1%), *Unionicola crassipes* (25.0%), *U. minor* (12.5%), and *Piona pusilla* (8.9%).

2. *Caricetum* — 28 species of water mite with a total number of 166 individuals were found. Two of them were lacustrine, 7 eurytopic and 10 small water body species, while 9 were astatic ones.

3. *Phragmitetum communis* — 9 species with a total number of 16 individuals were found, including 3 lacustrine, 3 eurytopic, 3 small body, and 3 astatic species.

4. *Ceratophylletum demersi* — 19 species with a total number of 167 individuals were found, including 2 lacustrine, 7 eurytopic, 5 small water body, 1 astatic, and 2 sphagnophile species.

5. *Nupharo-Nymphaeetum* — 15 species of water mite were observed with a total number of 125 individuals, including 6 lacustrine, 6 eurytopic, 2 small water body, and one astatic species.

The dynamics of occurrence of water mites in this lake in the annual cycle (fig. 5) was characterized by a high Spring peak.

4.3.3. Lake Dębiniec

In this lake 63 species of water mite were found with a total number of 1701 individuals (Table I). Among the species collected 41 numbered no more than 10 individuals, i.e. 5.1% of all species and 13.2% of the total collected material. Just as in Lake Brzostek, several zones were distinguished connected with depth and a few different types of environment of occurrence of the mites in particular zones. The structure of domination of water mite species most numerous in particular zones is presented in fig. 4.

1. Silts — 11 species of water mite were found, all of them small in number, with a total of 22 individuals, including 8 lacustrine and 4 eurytopic species.

2. Shallow littoral (depth to 0.5 m)
Sandy bottom — 8 species of water mites were observed with a total number of 67 individuals, including 3 lacustrine, 4 eurytopic, and 1 small water body species.
Silty bottom with organic remains - 12 species were found with a

total number of 51 individuals, 4 of them lacustrine, 4 eurytopic, 2 small water body, and 2 astatic species.
Caricetum — 18 species of water mite were recorded with a total number of 187 individuals, including 1 lacustrine, 4 eurytopic, 4 small water body, 9 astatic species.
Mosses - 16 species were found with a total number of 172 individuals including 1 lacustrine, 3 eurytopic, 3 small water body, 7 astatic, and 2 sphagnophile species.

3. Middle littoral (depth 0.5-1 m) - *Phragmitetum communis* — 30 species with a total number of 354 individuals were found. Among them 12 lacustrine and 9 eurytopic species, while 7 were small body water ones.

4. Deep littoral (depth 1-3 m) - *Charetum tomentose* — 13 species were found with a total number of 142 individuals, including 7 lacustrine, 4 eurytopic, and 2 small water body species.

5. Profundal zone (depth 3-7 m) — 16 species of water mite with a total number of 138 individuals, including 9 lacustrine, 6 eurytopic and 1 small water body species.

Additionally, the environment of the inside the mollusc mantle cavity was distinguished. Here three species were found, i.e. *Unionicola ypsilophora* (51.6%), *U. intermedia* (45.2%), and one individual of *Midea orbiculata*.

The dynamics of occurrence of water mites in Lake Dębiniec in the annual cycle was characterized by a high Spring peak (fig. 5). This peak, besides apart from characteristic species for Spring fauna was also caused by eurytopic species, chiefly by *Hydrodroma descipiens*.

5. Discussion

The material collected in Lakes Brzostek, Dębiniec, and Drążynek was characterized by a wide diversification of species that should be specially emphasized considering the small size of these lakes. This faunal wealth is particularly seen in comparison with the results of investigations on Hydracarina of large lakes (P i e c z y ń s k i 1959, 1960a,b, 1963, 1964, 1967, 1976, B i e s i a d k a 1972a, K o w a l i k 1973, 1977, 1978). A comparable number of species were observed only in the Konin lakes (B i e s i a d k a 1977),

characterized, however, by much larger sizes. A certain curiosity of the investigated lakes is also the low quantitative share and small number of typical lacustrine species with a similtaneously large number of small water body species and those connected with astatic waters.

The *Hydrachna crassipalpis* species found in the investigated lakes is known only from two stations in Poland (B i e s i a d k a et al. 1989). *Arrenurus suecicus* is a new species for Poland (Z a w a l 1985).

The other characteristic feature distinguishing the collected material is the great number of species with small numbers. A similar number of species with small numbers was recorded only in Lake Licheńskie (B i e s i a d k a 1977), characterized by a high degree of destabilization as a result of a higher water temperature. It may be assumed that such a great quantity of species with small numbers having small numbers of lacustrine species and large ones of small water body species is characteristic for the fauna of strongly eutrophied lakes. It suggests also that the fauna of the investigated lakes is becoming similar to that of small eutrophic water bodies.

The faunal diversification of the investigated lakes leads to differences in the generally small numbers of lacustrine species and of those connected with the Spring fauna of astatic waters. The greatest numbers of lacustrine species were recorded in Lake Dębiniec followed by Lake Brzostek. On the other hand, the largest quantitative share of Spring water mites of astatic waters appeared in Lake Drążynek followed by Dębiniec, this being connected with stronger formation in these lakes, particularly in Lake Drążynek in its inshore astatic zones. These observations and especially the share of Spring fauna in the total faunal structure find confirmation in the annual course of numerical changes in the investigated lakes (fig. 5).

If may be assumed that Lakes Dębiniec and Brzostek have identical origin, similar size and surroundings and that they are at the same stage of intensively advanced eutrophication, while Lake Drążynek is distinctly more eutrophied. Faunal differences between Lakes Brzostek and Dębiniec show different ways of faunal transformations occurring in eutrophication processes and the significance of the degree of formation of astatic zones for these transformations. It may be expected that lake Dębiniec will evolve in the direction similar to the fauna of the present Lake Dębiniec, connected with that of fens. The faunal transformations in Lake Brzostek seem to consist in the entirely elimination of lacustrine species and a greater share of eurytopic and small body species,

hence the fauna of water mites will undergo transformation into fauna typical of small eutrophic bodies.

In analysing the fauna of particular environments of the investigated lakes some regularities may be noted. In Lake Drążynek in all the distinguished environments a visible share of water mites connected with astatic waters was observed. In Lake Brzostek in sedgeland, though weakly formed, there dominated species originating from this, certainly well formed reed community. The fauna of Lake Dębiniec showed in this respect indirect features. The strongly formed fauna of astatic waters penetrated other environments, in particular *Phragmitetum communis*. However, there could be seen a certain relatively high degree of faunal separateness in the environments occurring here.

When summing up the present considerations, it may be stated that in small, strongly eutrophied lakes the fauna of water mites intensively depends on the composition of the environment. At the same time, a strong development or lack of astatic zones is here a factor of substantial meaning.

6. Polish summary

Wodopójki (Hydracarina) trzech niewielkich jezior okolic Poznania

Od kwietnia do listopada 1982 roku prowadzono badania nad wodopójkami jezior: Dębiniec, Brzostek i Drążynek (ryc. 1). Pojedyńcze próby pobrano dodatkowo w marcu 1983 roku. Zebrano 3154 imagines, 1005 deutonimf i 18 larw 92 gatunków wodopójek. Dużą niespodzianką było znalezienie dwóch niezwykle rzadkich gatunków - *Hydrachna crassipalpis* i *Arrenurus succicus* (gatunek nowy dla Polski). Ogólną ocenę statystyczną zebranego materiału przedstawia ryc. 2.

Omówiono charakter fauny badanego terenu, zwracając szczególną uwagę na dominację i frekwencję (tabela I). Najliczniejsze były: *Hydrodroma despiciens, Unionicola crassipes, Brachypoda versicolor, Arrenurus albator, A. globator* i *A. inexploratus*.

Podjęto próbę określenia statystycznych podobieństw między poszczególnymi stanowiskami (ryc. 3). W oparciu o fenologię (ryc. 5) i struktury dominacyjne środowisk (ryc. 5) opisano charakter fauny wodopójek poszczególnych jezior i wykazano przydatność zgrupowań wodopójek jako wskaźników kondycji biologicznej jeziora. Z otrzymanych danych wynika, że charakter fauny wodopójek jezior eutroficznych zależy od struktury środowisk oraz może ewoluować w kierunku drobnych zbiorników trwałych lub torfowisk niskich.

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