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Eligiusz PIECZYŃSKI

SOME REGULARITIES IN THE OCCURRENCE OF WATER MITES (*HYDRACARINA*) IN THE LITTORAL OF 41 LAKES IN THE RIVER KRUTYNIA BASIN AND THE MIKOŁAJKI DISTRICT*

Analysis was made of the occurrence of different species of water mite and of the formation of groupings of *Hydracarina* in shallow littoral environments. A total of 48 species was found to occur, differing as to abundance and degree of distribution. The lakes included in the group examined in general exhibit considerable similarity of the specific composition of *Hydracarina*. Parallel development of groupings of water mites was found in littorals with and without emergent vegetation, characterised by peak abundance in July and maximum percentage of nymphs in August. It was also found that when the number of species increased, the level of the dominating species was reduced, while the abundance of individuals increased. With an increase in the abundance of individuals, on the other hand, the level of the dominating species does not alter.

I. AIM OF THE WORK, STUDY AREA AND METHODS

The aim of the present work was to analyse the occurrence of water mites in the littoral of selected Masurian lakes. Particular attention was paid to grasping regularities in the formation of groupings.

The study area consisted chiefly of the lakes in the Krutynia river basin and lakes near Mikołajki, situated in the Olsztyn province, in the Mrągowo and Szczytno districts. The Krutynia river basin has been given hydrographical treatment (Kondracki and Mikulski 1958), which includes a large amount of morphometrical data on the lakes occurring in this area. A total of 41 lakes were examined, 38 of which belong to the Krutynia river basin. Only the environment consisting of the shallow littoral not exceeding 50 cm.(most frequently 20–30 cm.) in depth was taken into consideration in all these lakes. Two littoral stands were chosen on 13 lakes, and one on each of the remainder. The work

*From the Institute of Ecology Polish Academy of Sciences, Warszawa.

General data on the lakes examined and the water mite material obtained

Tab. I

	Name of lake	Area in ha.	Limnological type[1]	Number of stands	Date (1959)	Number of samples	Number of individuals	Number of species
1	Mokre	797.0	(1a)	2	16.VI – 14.IX	24	250	13
2	Mikołajskie[2]	470.0	(1a)	2	30.V – 10.IX	48	1688	23
3	Gielądzkie	416.0	(1a)	1	20.VIII	3	61	8
4	Białe	374.0	(1a)	1	31.VIII	3	63	8
5	Rańskie	282.0	(2)	1	10.VIII	3	109	8
6	Piłakno	278.7	(3)	2	6.VIII	6	19	6
7	Lampackie	278.0	(1a)	1	20.VIII	3	181	15
8	Nawiady	272.5	(1a)	2	24.VI	6	93	18
9	Babięty Wielkie	271.1	(3)	2	8.VI – 15.IX	24	884	28
10	Zdrużno	246.8	(1a)	1	24.VIII	3	776	16
11	Zyzdrój Wielki	200.1	(1a)	2	16.VI – 14 IX	24	581	18
12	Pierwój	152.0	(1b)	1	6.VIII	3	45	9
13	Krzywe	140.0	(1a)	1	26.VIII	3	10	6
14	Stromek	140.0	(2)	1	6.VIII	3	108	13
15	Dłużec	127.0	(1a)	2	12.VI – 14.IX	24	932	22
16	Gardyńskie	107.0	(2)	2	7.VI – 2.IX	6	299	15
17	Kołowin Wielki	82.5	(2)	1	31.VIII	3	98	8
18	Krawno Wielkie	80.2	(1b)	1	13.VIII	3	236	14
19	Lampasz	76.0	(1a)	2	12.VI – 12.IX	24	1429	29
20	Babięty Małe	73.3	(2)	1	6.VIII	3	99	10
21	Uplik	61.9	(1a)	1	24.VIII	3	151	11

22	Jerzewko	59.0	(2)	1	2.IX	3	91	12
23	Kierwik	59.0	(1a)	1	24.VIII	3	57	10
24	Pupskie	54.1	(2)	1	24.VIII	3	134	13
25	Warpuńskie	49.5	(2)	2	26.V – 12.IX	24	473	15
26	Zyzdrój Mały	42.4	(1a)	1	24.VIII	3	39	12
27	Gant	37.8	(1a)	1	26.VIII	3	112	12
28	Tejsowo	35.2	(1b)	1	13.VIII	3	26	6
29	Krawno Małe	35.0	(1b)	1	13.VIII	3	108	15
30	Pustniki	33.2	(1b)	1	20.VIII	3	205	9
31	Mojtyńskie	32.6	(2)	2	24.VI	6	82	13
32	Miętkie	31.7	(2)	2	16.VI – 15.IX	24	922	19
33	Kujno	30.0	(2)	2	12.VI – 12.IX	24	2157	19
34	Borówko	29.0	(4)**	1	26.VIII	3	11	4
35	Kołowin Mały	25.8	(1a)	1	31.VIII	3	120	12
36	Słupek	23.0	(1b)	1	10.VIII	3	194	11
37	Janowskie	18.6	(1a)	1	20.VIII	3	174	17
38	Lisunie	13.0	(2)	1	30.V – 2.IX	21	672	28
39	Kały	7.0	(2)	1	13.VIII	3	114	13
40	Flosek	3.0*	(4)	1	1.VI, 14.VI	6	93	9
41	Karłowo[2]	1.0*	(1a)	1	30.V	3	101	9

[1](1a) – Eutrophic lakes, (1b) – Eutrophic lakes with sulphuretted hydrogen on the bottom during the stagnation period, (2) – "pond" lakes (acc. to terminology used by Stangenberg 1936), (3) – mesotrophic lakes, (4) – dystrophic lakes,
[2] – lakes not belonging to the Krutynia river basin, * – approximate data, ** – dystrophy faintly expressed.

was carried out during the vegetation season of 1959, from 26.V. to 15.IX. Material was collected eight times (from 1 lake), seven times (1 lake), four times (8 lakes), twice (2 lakes) and once (29 lakes).

Samples were taken by means of a dipper 15 cm. in diameter. One sample consisted of 20 strokes of the dipper. A series of 3 samples was taken from each of the environments examined.

Basic data on the lakes examined and detailed information on the number of stands, period during which samples were taken, number of samples and amount of material obtained from each lake are set out in Table I. The lakes investigated differ greatly as to size. The largest – Lake Mokre, is almost 800 ha. in area, while the smallest – Lake Karłowo, is scarcely 1 ha. Typological differences are fairly distinct[1]. A total of 24 eutrophic lakes can be distinguished (including 6 lakes with sulphuretted hydrogen on the bottom during the stagnation period), 13 "pond" lakes (according to the terminology used by Stangenberg, 1936), and 2 mesotrophic and 2 dystrophic lakes.

A total of 54 littoral environments were examined in these 41 lakes, taking 369 samples. Material consisting of 13997 individual water mites was collected.

II. GENERAL DESCRIPTION OF THE OCCURRENCE OF WATER MITES

The occurrence of 48 species of water mites was established in the 41 lakes examined (Tab. II). Four purposes of comparison it may be stated that in 47 North German lakes (chiefly lakes in Holstein) the occurrence of 77 species was confirmed (Viets 1924). This author, however, took into consideration a far greater number of lake environments (8 zones), including, in addition to the littoral, the sublittoral, profundal and limnetic zone. In the Krutynia lakes only the environments analogical with two of the zones distinguished by Viets were analysed, that is, the zones affected by surf movement ("Die Brandungszone") and zones of emergent vegetation („*Phragmites* und *Scirpus lacustris* Zone"). Another work by this same author (Viets 1930) covering material from 50 North German lakes, but where the mosaic character of the environments is less pronounced (chiefly the deeper zones of the lakes), gives 58 species as the number found.

The different species of water mites in the group of Masurian lakes examined differ as to abundance and degree of distribution (Tab. III). To facilitate analysis five classes of abundance were distinguished: from very small (class I) to very great (class V). In the same way 5 classes of distribution were distinguished: from very narrow (class I) to very vide (class V).

The following 5 species occur very abundantly (class V): *Hydrodroma despiciens*, *Limnesia maculata*, *Unionicola crassipes*, *Piona conglobata* and

[1] Information on the typology of the lakes discussed was taken from the unpublished materials of Polish Academy of Sciences the Hydrobiological Station at Mikołajki.

Occurrence of each species of water mite in the lakes of the Krutynia river basin and near Mikołajki

Tab. II

Species	Lakes																																							
	1. Mokre	2. Mikołajskie	3. Cielądzkie	4. Białe	5. Rańskie	6. Piłakno	7. Lampackie	8. Nawiady	9. Babięty Wielkie	10. Zdrużno	11. Zyzdrój Wielki	12. Pierwój	13. Krzywe	14. Stromek	15. Dłużec	16. Gardyńskie	17. Kołowin Wielki	18. Krawno Wielkie	19. Lampasz	20. Babięty Małe	21. Uplik	22. Jerzewko	23. Kierwik	24. Pupskie	25. Warpuńskie	26. Zyzdrój Mały	27. Gant	28. Tejsowo	29. Krawno Małe	30. Pustniki	31. Mojtyńskie	32. Miętkie	33. Kujno	34. Borówko	35. Kołowin Mały	36. Słupek	37. Janowskie	38. Lisunie	39. Kały	40. Flosek	41. Karłowo
Hydrachna cruenta Müller 1776									X					X										X																	
H. globosa (Geer 1778)									X												X	X	X	X					X				X					X	X		
H. uniscutata (Thor 1897)																												X					X								
Limnochares aquatica (Linnaeus 1758)									X					X	X		X																					X		X	
Eylais rimosa Piersig 1899 (?)		X						X	X		X								X	X											X	X	X			X	X	X		X	X
Hydrodroma despiciens (Müller 1776)	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X	X
Lebertia sp.	X	X					X	X	X	X	X	X			X			X	X						X				X										X		
Oxus ovalis (Müller 1776)		X						X							X	X			X			X													X			X	X		
Frontipoda musculus (Müller 1776)		X															X		X								X								X			X			
Limnesia connata Koenike 1895									X												X												X					X			
L. fulgida Koch 1836									X					X										X								X	X					X			
L. maculata (Müller 1776)		X	X		X	X	X	X	X	X	X	X			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
L. polonica Schechtel 1910	X						X		X					X			X	X									X		X			X			X	X	X	X	X		
L. undulata (Müller 1776)		X		X	X					X	X		X		X			X	X				X	X	X	X	X		X	X	X	X	X					X			
Hygrobates longipalpis (Hermann 1804)	X	X	X	X	X		X	X	X	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X		X		X	X	X			X	X	X			
H. nigromaculatus Lebert 1879	X	X						X		X					X				X						X								X								
H. trigonicus Koenike 1895																			X														X								
Atractides ovalis Koenike 1883	X	X				X			X						X				X	X																		X	X		
Unionicola crassipes (Müller 1776)	X	X	X	X			X	X	X	X	X		X	X	X	X	X		X	X	X	X			X		X	X		X	X	X	X			X		X			
U. aculeata (Koenike 1890)																			X																						
U. figuralis (Koch 1836)																																	X								
Neumania deltoides (Piersig 1894)																									X																
N. vernalis (Müller 1776)					X				X		X		X	X				X	X							X			X			X				X	X		X	X	X
Hydrochoreutes krameri Piersig 1894															X				X							X	X					X					X	X			X
Pionopsis lutescens (Hermann 1804)															X																	X						X			
Piona coccinea (Koch 1836)	X	X					X	X	X	X	X	X	X		X	X		X	X			X	X	X	X		X		X	X	X	X	X			X	X	X	X		X
P. conglobata (Koch 1836)	X	X	X	X	X	X	X	X	X	X	X	X			X	X		X	X	X		X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	X
P. longipalpis (Krendowskij 1878)		X							X							X			X			X									X						X	X			
P. neumani (Koenike 1883)									X		X								X																						
P. rotunda (Kramer 1879)		X						X	X	X	X			X		X									X	X			X			X			X		X	X			
P. variabilis (Koch 1836)	X	X					X	X	X		X				X	X		X	X	X					X						X		X		X		X	X			X
Piona sp.(nymphae)																					X									X				X							
Forelia liliacea (Müller 1776)		X				X	X			X	X			X	X	X			X		X		X		X							X	X							X	
F. variegator (Koch 1837)	X																																								
Brachypoda versicolor (Müller 1776)	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Midea orbiculata (Müller 1776)									X							X										X											X	X			
Mideopsis orbicularis (Müller 1776)		X	X		X	X		X	X	X	X				X				X						X				X		X	X				X		X			
Arrenurus albator (Müller 1776)		X	X				X	X	X	X					X				X												X				X			X			
A. batillifer Koenike 1896																																			X						
A. bicuspidator Berlese 1885								X											X																						
A. claviger Koenike 1885								X									X		X																X			X			
A. crassicaudatus Kramer 1875		X		X	X		X		X	X	X	X			X	X		X	X		X		X	X						X							X	X			
A. latus Barrois et Moniez 1887														X																											
A. neumani Piersig 1895																																								X	
A. tricuspidator (Müller 1776)							X											X																							
A. buccinator (Müller 1776)									X																																
A. globator (Müller 1776)		X		X				X	X		X	X		X	X	X	X		X	X	X	X		X		X	X		X	X	X	X	X		X		X	X	X	X	X
A. perforatus George 1881																										X															
A. sinuator (Müller 1776)		X					X		X	X				X	X			X	X					X		X			X								X		X		
Arrenurus sp.	X																					X										X								X	X

Abundance and distribution of each species of water mite

Tab. III

Species	Abundance (total of captured specimens)					Distribution	
	♀♀	♂♂	ny	Total	Classes of abund-ance	Number of lakes	Classes of distri-bution
Hydrachna cruenta	3		1	4	I	3	I
H. globosa	13		7	20	I	9	II
H. uniscutata	2		1	3	I	2	I
Limnochares aquatica	40		11	51	II	6	I
Eylais rimosa (?)	39		4	43	II	14	II
Hydrodroma despiciens	1087	319	1082	2488	V	38	V
Lebertia sp.	98		5	103	III	14	II
Oxus ovalis	15		3	18	I	9	II
Frontipoda musculus	11		–	11	I	6	I
Limnesia connata	5	7	–	12	I	4	I
L. fulgida	3	4	–	7	I	6	I
L. maculata	668	868	848	2384	V	34	V
L. polonica	24	89	1	114	III	14	II
L. undulata	294	234	122	650	IV	20	III
Hygrobates longipalpis	195	215	307	717	IV	31	IV
H. nigromaculatus	59	58	9	126	III	8	I
H. trigonicus	22	18	–	40	II	2	I
Atractides ovalis	34	6	–	40	II	9	II
Unionicola crassipes	842	382	394	1618	V	27	IV
U. aculeata	–	1	–	1	I	1	I
U. figuralis	1	–	–	1	I	1	I
Neumania deltoides	1	2	–	3	I	1	I
N. vernalis	70	14	7	91	III	15	II
Hydrochoreutes krameri	20	1	8	29	II	8	I
Pionopsis lutescens	3	1	–	4	I	3	I
Piona coccinea	244	89	201	534	IV	28	IV
P. conglobata	1214	308	62	1584	V	34	V
P. longipalpis	13	5	6	24	II	8	I
P. neumani	8	3	–	11	I	3	I
P. rotunda	34	7	–	41	II	14	II
P. variabilis	234	106	–	340	IV	18	III

Tab. III (cont.)

Species	Abundance (total of captured specimens)					Distribution	
	♀♀	♂♂	ny	Total	Classes of abundance	Number of lakes	Classes of distribution
Forelia liliacea	63	31	1	95	III	15	II
F. variegator	1	–	–	1	I	1	I
Brachypoda versicolor	1520	250	62	1832	V	37	V
Midea orbiculata	10	–	–	10	I	5	I
Mideopsis orbicularis	72		1	73	III	16	II
Arrenurus albator	–	48	–	48	II	11	II
A. batillifer	–	1	–	1	I	1	I
A. bicuspidator	5	–	–	5	I	2	I
A. claviger	51	46	–	97	III	5	I
A. crassicaudatus	–	73	–	73	III	18	III
A. latus	–	8	–	8	I	1	I
A. neumani	5	1	–	6	I	1	I
A. tricuspidator	2	1	–	3	I	2	I
A. buccinator	–	2	–	2	I	1	I
A. globator	68	70	1	139	III	28	IV
A. perforatus	–	1	–	1	I	1	I
A. sinuator	–	35	–	35	II	13	II

Classes of abundance: I: very low abundance (1–20 specimens); II: low (24–51); III: medium (73–139); IV: high (340–717); V: very high (1584–2488).
Classes of distribution: I: very narrow distribution (1–8 lakes); II: fairly narrow (9–16); III: medium (17–25); IV: wide (26–33); V: very wide (34–41).

Brachypoda versicolor. With the exception of *Unionicola crassipes*, these are widely distributed species (class V).

Four species are distinguished by considerable abundance (class IV): *Limnesia undulata*, *Hygrobates longipalpis*, *Piona coccinea* and *Piona variabilis*. Four other species are also widely distributed (class IV): *Hygrobates longipalpis*, *Unionicola crassipes*, *Piona coccinea* and *Arrenurus globator*.

There are 9 species in class III of abundance, and also 9 in class II, and 21 species in class I. Class III of distribution is represented by 3 species, class II by 12 and class I – 25 species.

In order to grasp possible differences in the occupation by water mites of each lake the index of species similarity was used. This index has been applied primarily in phytosociological research (Kulczyński 1939, Traczyk 1960). The well-known formula of Jaccard and Steinhaus was used:

$$P = \frac{2c \cdot 100}{a + b}$$

where P – is the index of similarity expressed in percentages, c – the number of species common to the two lakes compared, a – the number of species in the first lake, b – the number of species in the second lake.

High values of the index were in general obtained. To illustrate this, comparison was made of the distribution of indices of species similarity in the water mite fauna of the lakes examined with the distribution of the same index for the vegetation of the peat-bogs of the Polesie region (acc. to Kulczyński 1939, altered). A greatly contrasting course taken by curves was obtained (Fig. 1). The distribution of indices of similarity for the vegetation of peat-bogs

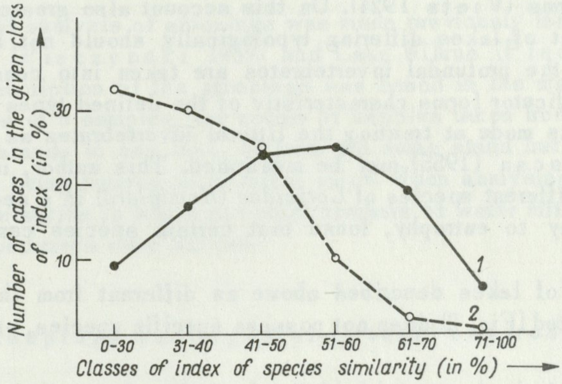

Fig. 1. Comparison of distribution of indices of species similarity for water mite fauna in the group of lakes examined and in the vegetation of the peat-bogs of the Polesie region (acc. to Kulczyński 1939, altered).

1 – lake water mite fauna, 2 – peat – bogs vegetation

is characterised by a maximum when the lowest values of the index (0–40%) are obtained. On the other hand the distribution of the indices for lake water mite fauna exhibits a maximum when the values of the index are fairly high (41–60%). In consequence Kulczyński succeeded (by using Czekanowski's tables) in distinguishing two large antilogical associations of peat-bogs. In the case of water mite fauna the distribution of indices of similarity shows that fundamental differences between the lakes examined should not be expected. Further analysis was therefore aimed only at confirming which of the lakes deviates most from the group of lakes. This analysis consisted in defining the degree of similarity between the given lake and the whole group of lakes examined.

The degree of similarity to the whole of the lakes examined is defined by the number of lakes with which the given lake has an index of species similarity higher than 50%.

The above analysis showed that 29 lakes exhibit a high degree of similarity to the whole of the lakes, while 12 exhibit a low degree (Fig. 2). The figure for the degree of similarity of the first comes within limits of 19–32, the second: 1–15. In the large group of lakes similar to the whole of those examined there is one mesotrophic lake (Babięty Wielkie), 10 "pond" lakes and 18 eutrophic lakes. Among the lakes differing from the whole of those examined there are 2 dystrophic lakes (Flosek and Borówko), 1 mesotrophic lake (Piłakno), 3 "pond" lakes (Stromek, Kołowin Wielki and Rańskie), and 6 eutrophic lakes (Karłowo, Kołowin Mały, Krzywe, Zyzdrój Mały, Mokre and Tejsowo).

The above classification of the lakes, made according to the degree of similarity of water mite fauna, does not in general coincide with the typological classification. The great majority of the littoral species of water mites belong to eurytopic forms (Viets 1924). On this account also greater differences in their settlement of lakes differing typologically should not be expected. In principle only the profundal invertebrates are taken into consideration when establishing indicator forms characteristic of the defined types of lake. Among the few attempts made at treating the littoral invertebrates as indicator forms the work by Macan (1955) may be mentioned. This author, in analysing the occurrence of different species of *Corixidae* (*Hemiptera*) in a sequence of lakes from oligotrophy to eutrophy, found that certain species can be treated as indicator forms.

The group of lakes described above as different from the whole of the lakes investigated (Fig. 2) does not possess specific species, proper only to it.

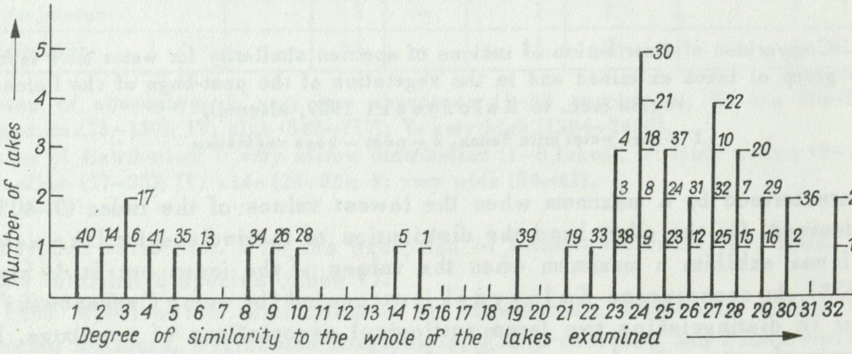

Fig. 2. Differentiation of water mite fauna in the group of lakes examined. Figures indicate each lake according to ordinal numbers set out in Tab. I

The difference arises more from the different number of species occurring. The group of lakes with a low degree of similarity is characterised by a small number of species (from 4 to 13, on an average 8.8). The group of lakes with a high degree of similarity has a far greater number of species (from 8 to 29, average 15.5).

Despite the fact that in general differences in the composition of the water mite fauna between each lake cannot be explained by differences in typological character, it is worthy of note that among the lakes most greatly differing from the group of lakes examined are the two dystrophic lakes.

III. CHARACTERISTICS OF THE GROUPINGS OF WATER MITES

The grouping of water mites is a faunistic-ecological unit covering the whole of the water mites in a given environment[2]. The total abundance of individuals, number of species and qualitative composition are the characteristic features of the grouping which are primarily taken into consideration in an analysis.

This kind of analysis of groupings was made previously for the water mites in Lake Tajty (Pieczyński 1959) and Lake Wilkus (Pieczyński 1960, 1960a). The description of the groupings was based in the material presented here on a series of 3 samples, the series of samples taken from different lakes from different stands in one lake, or from the same stand but from a different capture period, being treated as of equal value. When analysing the qualitative composition the series in which the total numbers of water mites captured was less than 15 specimens were omitted.

1. Groupings and types of littoral environments

The environments analysed may be divided into two basic types:

1. littoral with emergent vegetation and 2. littoral without emergent vegetation. Other elements differentiating these two types of environment may be taken as including the different effect of wave movement (greater in the second type) and the different character of the bottom (far greater amount of decaying plant particles in the first type). In the first type of habitats the dominating species of plant is usually reed (*Phragmites communis* T.), than sweet flag (*Acorus calamus* L.), cattail (*Typha angustifolia* L.) and bulrush (*Scirpus* sp.). In the second type of habitats without emergent vegetation, a series of species of underwater plants were encountered, such as pondweed (*Potamogeton* sp.), coontail (*Ceratophyllum* sp.), water milfoil (*Myriophyllum* sp.) and water moss (*Fontinalis antipyretica* L.), etc. The density of these plants was as a rule very slight, but occasionally they formed dense submerged meadows. In the first type of environment these species were only sporadically encountered.

Analysis of the groupings in the above types of littoral environment consisted in tracing the variations in total numbers of water mites and the relative abundance of nymphs during the vegetation season.

[2] The term "grouping" coincides in principle with the term taxocen proposed by Chodorowski (1960).

Character of development of groupings
of water mites in different types of littoral environments

Tab. IV

Months	Types of littoral environments					
	Littoral with emergent vegetation			Littoral without emergent vegetation		
	A	B	C	A	B	C
VI	17	35.3	8.2	13	12.8	8.7
VII	20	53.9	24.3	14	48.2	33.9
VIII	27	43.6	30.0	11	43.4	38.3
IX	13	21.8	15.6	8	26.0	23.3

A – number of environments examined, B – total abundance of water mites (average per dipper), C – relative abundance of nymphs (in %).

In both types of littoral environment the maximum abundance can be observed in July, while the highest percentage of nymphs occurs in August (Tab. IV). The development of the groupings in the types of environment differentiated is therefore in principle even. It is only in June that the abundance in the first type of environment greatly exceeds the abundance in the second type. This is probably the result of the later (in relation to emergent vegetation) development of submerged plants. After attaining peak numbers in July, a decrease ensues, inconsiderable in August, but more distinct in September. The percentage of nymphs in both types of environment increases from June to August, while in September it clearly decreases. In the second type of environment it is always slightly higher.

2. Domination in the groupings

When defining domination structure species, the numbers of which exceed 30% of the total numbers of the grouping are taken as being dominants, and species forming from 10 to 30% of the whole grouping – as influents. The following facts resulting from the specific nature of the material argue in favour of the correctness of such division:

1) In each grouping, in 95% of the cases, only one species exceeds the level of 30%

2) The difference between the species exceeding the level of 30% (dominant) and the second species in order of abundance is on an average 29.5%

3) In cases where there is no dominant in the grouping, the difference between the two most numerous species is on an average 4.9%.

The above analysis refers also to the plankton species *Unionicola crassipes*, which in previous works (Pieczyński 1959, 1960) was not treated as an equivalent component of the grouping. Detailed investigation however (using different capture methods) of the distribution in space of water mites in the littoral (Pieczyński, materials not published), revealed the considerable similarity in the character of occurrence of this species to that of several other species exhibiting a predisposition to occurrence in the bottom zone of the given littoral.

Comparison of dominant and influent species in groupings of water mites

Tab. V

Species	Number of cases in which the species is a dominant	Number of cases in which the species is an influent
Hydrodroma despiciens	20	30
Limnesia maculata	19	42
Piona conglobata	16	30
Brachypoda versicolor	11	35
Unionicola crassipes	6	24
Hygrobates longipalpis	5	12
Limnesia undulata	4	16
Piona variabilis	2	10
P. coccinea	–	18
Hygrobates nigromaculatus	2	1
Limnesia polonica	1	1
Arrenurus globator	1	3
Neumania vernalis	1	4
Arrenurus claviger	–	5
Lebertia sp.	–	3
Limnochares aquatica	–	3
Mideopsis orbicularis	–	2
Forelia liliacea	–	2
Arrenurus crassicaudatus	–	1
Hydrochoreutes krameri	–	1
Hygrobates trigonicus	–	1

Within frames – commonest dominants and influents

A total of 12 dominating species were found to occur in the groupings of water mites and 21 influent species (Tab. V). The following 4 species are among the commonest of the dominating species: *Hydrodroma despiciens*, *Limnesia maculata*, *Piona conglobata* and *Brachypoda versicolor*, while the commonest influent species include 9 species: *Limnesia maculata*, *Brachypoda versicolor*, *Hydrodroma despiciens*, *Piona conglobata*, *Unionicola crassipes*, *Piona coccinea*, *Limnesia undulata*, *Hygrobates longipalpis* and *Piona variabilis*.

An analysis was made of how the number of cases of domination of the commonest dominants varies during the course of the vegetation season (Fig. 3).

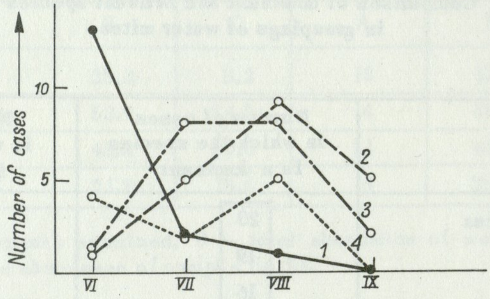

Fig. 3. Number of cases of occurrence of each species as dominants in the groupings of water mites – variations during the vegetation season.
1 – *Piona conglobata*, 2 – *Hydrodroma despiciens*, 3 – *Limnesia maculata*, 4 – *Brachypoda versicolor*

Piona conglobata exhibits the highest number of cases of domination in June, a distinct and continuous decrease occurring in the following months. *Hydrodroma despiciens* and *Limnesia maculata* behave differently from *Piona conglobata* in this respect. The number of cases of domination of these species is very small in June, the maximum number occurring in August (*Hydrodroma despiciens*), or during the period July–August (*Limnesia maculata*). The number decreases considerably in September in the case of both species. *Brachypoda versicolor* also exhibits the maximum number of cases of domination in August, but it is also fairly high in June as well.

Analysis was also made of how the number of cases of "influention"[3] varies during the vegetation season in the commonest influents (Fig. 4). Three groups of species may be distinguished. The first group includes the 5 commonest influents: *Limnesia maculata*, *Brachypoda versicolor*, *Hydrodroma despiciens*, *Piona conglobata* and *Unionicola crassipes*. This group attains a high number of cases of "influention" in July and August (maximum), the number being far smaller in the remaining months. The second group including *Piona coccinea* and *P. variabilis*, attains the highest number of cases of „influention" in June, the number gradually decreasing during the following months. Finally the third group to which *Limnesia undulata* and *Hygrobates longipalpis* belong, exhibits a fairly low and even number of cases of "influention" during the season.

[3] A provisional term, analogical with domination, meaning the situation in which the species is an influent in the grouping.

No distinct differences were found from the aspect of domination structure between the groupings in the littoral environments with emergent vegetation and groupings in the littoral environments without emergent vegetation. Differences in the course taken by domination between each species arise from

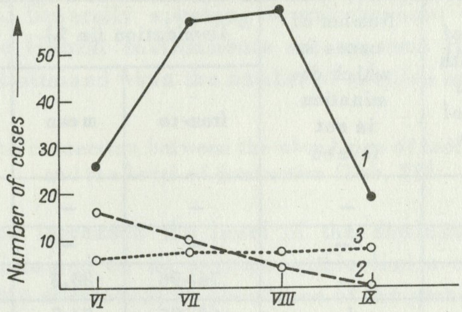

Fig. 4. Number of cases of occurrence of each species as influents in the groupings of water mites — variations during the vegetation season.
1 — *Limnesia maculata, Brachypoda versicolor, Hydrodroma despiciens, Piona conglobata, Unionicola crassipes*; 2 — *Piona coccinea, P.variabilis*; 3 — *Limnesia undulata, Hydrobates longipalpis*

the phenology of the life cycles. The uneven development of life cycles of species during the vegetation season and its effect of the course taken by domination phenomena were shown by an analysis of the groupings of water mites in Lake Wilkus (Pieczyński 1960). It was found, inter alia, that *Piona conglobata* has an earlier development cycle than *Limnesia maculata*, which was confirmed by the materials presented in this work (Fig. 3).

3. Certain connections in the formation of groupings

An analysis was made of the connections between the number of species and the level of domination and abundance of individuals and also the dependence between abundance and the level of domination. These will be discussed in turn.

a. The dependence between the number of species and the level of domination and abundance of individuals (Tab. VI)

This connection is in reverse proportion: with an increase in the number of species the level of the dominating species is reduced. The fact is characteristic that cases in which domination is not formed are particularly numerous with a high number of species (most numerous when there are 12 species in the grouping). With the highest numbers of species observed in the groupings (17–20, 24), none of them attains the level of a dominant.

Connection between the number
of species and the level of domination
and abundance of individuals in groupings of water mites

Tab. VI

Number of species	Number of cases with a given number of species	Number of cases in which domination is not formed	Domination (in %)		Abundance of individuals	
			from-to	mean	from-to	mean
1	–	–	–	–	–	–
2	1	–	–	–	–	3.0
3	7	–	76–96	88.3	4–54	22.0
4	10	1	63–96	74.0	5–92	26.2
5	5	–	38–72	57.5	8–66	34.6
6	7	–	33–60	49.2	10–196	53.1
7	10	1	35–69	52.7	23–164	88.2
8	12	3	32–56	42.2	16–246	104.1
9	11	2	31–57	41.8	27–663	181.7
10	9	–	32–59	40.3	38–165	84.0
11	6	2	43–65	53.5	55–194	119.3
12	16	9	35–78	52.0	39–422	141.9
13	8	2	33–61	39.3	42–317	122.9
14	3	–	38–57	45.0	134–302	224.0
15	7	2	31–43	36.8	60–235	154.1
16	2	–	38–68	50.3	412–776	594.0
17	3	3	–	–	85–277	178.7
18	1	1	–	–	–	235.0
19	1	1	–	–	–	162.0
20	1	1	–	–	–	137.0
21	–	–	–	–	–	–
22	–	–	–	–	–	–
23	–	–	–	–	–	–
24	1	1	–	–	–	168.0

When analysing domination the cases in which numbers were below 15 individuals were not taken into consideration. Therefore in the columns with 3, 4, 5 and 6 species, a smaller number of cases was analysed than shown in the column "Number of cases with a given number of species".

The connection between the number of species and the abundance of individuals in the groupings of water mites is distinctly evident, that is, the increase in the number of species is in general parallel with the increase in abundance. When the number of species is higher, uneven jumps in abundance take place, but to a considerable degree they result from too small a number of analysed cases. Generally speaking it may be said that the groupings of water mites in the littoral environments are systems in which a high level of abundance is not attained when the number of species are small.

b. The connection between the abundance of individuals and the level of domination (Tab. VII)

When abundance increases the level of the dominating species does not change, but is maintained on an average within limits of about 50%, despite the very considerable differences in abundance of the groupings.

Connection between abundance of individuals and level of domination in groupings of water mites

Tab. VII

Classes of abundance	Number of cases in given class of abundance	Number of cases in which domination is not formed	Domination (in %)	
			from-to	mean
15–20	5	2	33–63	44.7
21–40	12	2	32–79	58.6
41–60	18	5	32–96	53.2
61–80	11	3	34–63	46.1
81–100	12	4	31–96	50.3
101–120	15	3	32–71	43.1
121–140	9	3	32–69	46.8
141–160	5	–	35–65	44.2
161–180	5	3	50–59	54.5
181–200	4	1	38–55	45.3
201–300	8	2	31–57	45.8
301–400	4	–	35–78	52.8
400	4	1	38–68	48.0

The above connections indicate that the high level of abundance in the groupings of water mites depends to a very great extent on the abundance of influent species. With a general increase in abundance, the abundance of each component of the groupings increases proportionately, since no increase in the level of domination is observed. The above phenomenon would seem to be evidence that the abundance of each species in the groupings of water mites is independent of each other. If it were otherwise, an increase in the relative abundance of the dominant should be expected when there is an increase in the total abundance of the grouping (competition processes). The groupings of water mites may therefore be allocated to the second of the specific systems distinguished by MacArthur (1960). In the first of these, the abundance of components (species) depends on each other, i.e. an increase in the abundance of one species causes a decrease in the abundance of another species. In the second the abundance of the different species is independent of each other, i.e. variations in numbers are not correlated with each other.

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NIEKTÓRE PRAWIDŁOWOŚCI WYSTĘPOWANIA WODOPÓJEK (*HYDRACARINA*) W LITORALU 41 JEZIOR DORZECZA KRUTYNI I OKOLIC MIKOŁAJEK

Streszczenie

Pracę wykonano w sezonie wegetacyjnym 1959 roku na 38 jeziorach dorzecza Krutyni i 3 jeziorach okolic Mikołajek (woj. olsztyńskie). Celem pracy była analiza występowania wodopójek w środowisku płytkiego litoralu, ze szczególnym zwróceniem

uwagi na prawidłowości kształtowania się zgrupowań. Do połowów używano czerpaka o średnicy 15 cm, którym w każdym środowisku pobierano serię 3 prób po 20 machnięć czerpaka. Na poszczególnych jeziorach wytypowano 1 lub 2 stanowiska, na których próby pobierano od 1 do 8 razy w ciągu sezonu wegetacyjnego. Ogółem przeanalizowano 54 środowiska litoralne, w których pobrano 369 prób. Łącznie uzyskano materiał w ilości 13997 osobników wodopójek (tab. I).

W analizowanym kompleksie 41 jezior mazurskich stwierdzono występowanie 48 gatunków wodopójek (tab. II), zróżnicowanych pod względem liczebności i stopnia rozprzestrzenienia (tab. III). Przy analizie zróżnicowania jezior pod względem charakteru zasiedlającej je fauny wodopójek, posłużono się wskaźnikiem podobieństwa gatunkowego. Na ogół otrzymano wysokie wartości tego wskaźnika (fig. 1), wskazujące na wysoki stopień podobieństwa fauny wodopójek badanych jezior. Pod względem stopnia podobieństwa do ogółu badanych jezior, wyróżnić można dużą grupę (29 jezior) o wysokim stopniu podobieństwa oraz małą grupę (12 jezior) o niskim stopniu podobieństwa (fig. 2). Grupy te na ogół nie pokrywają się z podziałem jezior według właściwości typologicznych. Do najbardziej odbiegających od ogółu badanych jezior pod względem charakteru zasiedlającej je fauny wodopójek należą obydwa jeziora dystroficzne.

Przeprowadzono analizę rozwoju zgrupowań wodopójek w 2 typach środowisk: litoralu z roślinnością wynurzoną i litoralu bez roślinności wynurzonej. Stwierdzono na ogół równoległy rozwój zgrupowań w powyższych typach środowisk, charakteryzujący się szczytową liczebnością w lipcu i najwyższym procentem nimf w sierpniu (tab. IV).

W zgrupowaniach wodopójek zanotowano ogółem 12 gatunków dominujących (liczebność ponad 30% ogólnej liczebności zgrupowania) i 21 gatunków influentnych (liczebność w granicach 10–30%). Do najpospolitszych dominantów należą 4 gatunki, do najpospolitszych influentów – 9 gatunków (tab. V). Przedstawiono sezonową zmienność dominantów (fig. 3) i influentów (fig. 4).

Analizowano niektóre zależności w kształtowaniu się zgrupowań wodopójek. Stwierdzono, że przy wzroście liczby gatunków poziom dominującego gatunku obniża się, zaś liczebność osobników wzrasta (tab. VI). Przy wzroście liczebności osobników nie zmienia się poziom dominującego gatunku (tab. VII). Zależności te wskazują, iż wysoki poziom liczebności w zgrupowaniach wodopójek jest warunkowany w znacznym stopniu przez liczebność gatunków influentnych. Proporcjonalny wzrost liczebności poszczególnych gatunków w miarę wzrostu ogólnej liczebności przemawia za tym, że zgrupowanie wodopójek jest typem układu, w którym liczebność jego komponentów (gatunków) jest od siebie niezależna.

ADDRESS OF THE AUTHOR:
M. Sc. Eligiusz Pieczyński
Institute of Ecology,
Warszawa, ul. Nowy Swiat 72