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WATER MITES (ACARI, HYDRACHNIDIA) OF THE BUG RIVER VALLEY BETWEEN WŁODAWA AND KODEŃ

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Summary. In the Bug River valley between Włodawa and Kodeń 71 water mite species were collected. There were 59 species found in oxbow lakes, 10 in temporary pools, 10 in the Bug River, 9 in its tributaries, and 8 in meadow ditches. The most numerous species in the area were *Hydrodroma despiciens*, *Tiphys ornatus*, *Arrenurus bifidicodulus* and *Limnesia fulgida*. A characteristic feature of the water mite fauna of the Bug was the dominance of rheoxenes (95.1% of the material collected). Small water body species were dominant in the oxbow lakes (68.1%), while species typical of temporary vernal water bodies were dominant in the temporary pools (57.9%). Species diversity was highest in the oxbow lakes (4.3), lower in the temporary ponds (2.1), and only 1.6 in the Bug River. The water mite species composition varied substantially among the different types of water bodies; the faunal similarity between them was very low. Based on the data obtained it can be concluded that the key habitats shaping the biological diversity of the Bug River valley are the water bodies of the floodplain, mainly its oxbow lakes.

Key words: water mites, Bug River, oxbow lakes, temporary ponds, species diversity

INTRODUCTION

Water mites inhabiting running water have been considerably less well researched than Hydrachnidia of standing water. Studies on water mites of lowland running waters in Poland have been conducted by Bazan-Strzelecka [1964, 1986], Biesiadka [1970, 1972], Kowalik [1981], Kowalik and Biesiadka [1981], and Cichocka [1996a, b]. Most of those studies concern the fauna of rivers alone, without regard to water bodies of the floodplain. According to Žadin [qtd. in Biesiadka 1974], oxbow lakes are an integral part of the river system, as they originate from the river. For this reason it seems useful to conduct comprehensive studies on river valleys, i.e. on rivers together with water bodies of the valley. Thus far, studies including rivers together with water bodies of the floodplain have been conducted in mountainous areas [Biesiadka 1974], while in the case of lowland areas data on rivers and on the water bodies of their valleys have been presented in separate papers [eg. Bazan-Strzelecka 1962, 1963, 1964].

The Bug River is one of the main border rivers of Central and Eastern Europe. The Bug is one of the few European rivers whose beds have retained their natural character along nearly their entire course. In this area of such great natural interest, studies have been carried out only on selected groups of organisms. One group of animals that has not yet been studied in this region is water mites (Hydrachnidia). The aim of this study was to investigate the Hydrachnidia of the river itself as well as of the water bodies of its valley, and to determine the degree of interchange of fauna inhabiting the different types of water bodies.

STUDY SITE AND METHODS

Samples were collected from the Bug River (in Dołhobrody, Pawluki, Jabłeczna, Różanka, Suszno, Stawki, Sławatycze and Kodeń), from oxbow lakes (in Dołhobrody, Pawluki, Jabłeczna, Nowosiółki, Sławatycze, and Kodeń), from temporary pools (in Dołhobrody, Szuminka and Pawluki), from tributaries of the Bug (the rivers Hanna in Hanna and Kałamanka in Kodeń), and from meadow ditches (in Szuminka and Hanna).

Water mites were collected in the lentic zones of the river. The current was slow, and the bottom was muddy with little aquatic vegetation. Flooded grasses and osier hope grew near the shore. At the site in Kodeń the habitat was lotic, with fast water flow and a bottom of sand, gravel and stones.

The surface area and depth of the oxbow lakes varied considerably. They had abundant aquatic vegetation with zonal distribution: *Schoenoplectus lacustris*, *Typha angustifolia*, *T. latifolia*, *Acorus calamus*, *Glyceria maxima*, and *Phragmites australis* near the shore, and *Nuphar lutea*, *Nymphaea alba*, and *Hydrocharis morsus-ranae* in the Nymphaea zone. In more eutrophied water bodies, *Lemna minor* and *L. Trisulca* occurred. In the Elodea zone, *Stratiotes aloides*, *Myriophyllum* sp., *Ceratophyllum* sp. and *Utricularia* sp. were noted. In some of the oxbow lakes algal blooms were observed in the summer.

The temporary pools were formed in depressions in the floodplain. Their surface area showed considerable variability, from a few dozen m^2 in the spring to complete drying out in the summer. These were usually shallow water bodies with meadow vegetation resistant to periodic flooding.

The Bug tributaries in the study sites had straightened beds. They were 3–4 m wide and their depth varied from 0.1 to 0.6 m. The bottom was muddy near the shores and of mud and sand in the middle of the river. The water flow was slow and there was little aquatic vegetation, limited to the lentic zones.

Hydrobiological sampling was carried out during the vegetation season in 2006 and 2007. Semi-quantitative samples were taken using a hand net. Species diversity was calculated using the Shannon-Wiener index (base 2 logarithm). Faunal similarities were calculated using the Jaccard formula.

RESULTS

In the water bodies studied 1.279 Hydrachnidia specimens were caught (1.191 adults and 88 deutonymphs), from 71 species belonging to 22 genera and 14 families (Tab. 1). The families represented by the highest numbers were Pionidae

Table 1. Species composition and numbers of water mites collected in the Bug River Valley between Włodawa and Kodeń (2006–2007)

Taxon	A	B	C	D	E	Total
1	2	3	4	5	6	7
Hydrachna aspartilis Koen.			1			1
Hydrachna geographica Müll.			2			2
Hydrachna globosa (Geer)	9		2			11
Hydrachna leegei Koen.			5	1		6
Hydrachnta processifera Koen.			3			3
Limnochares aquatica (L.)			15			15
Eylais hamata Koen.	2		34			36
Eylais infundibulifera Koen.	51		1			52
Eylais koenikei Halb.	3		1	2		6
Eylais mutila Koen.	1		2			3
Eylais rimosa Piers.			2			2
Eylais setosa Koen.			1			1
Eylais sp.	4		5	1		10
Eylais sp. (deutonymhs)	4		1			5
Hydryphantes crassipalpis Koen.			2			2
Hydryphantes dispar (Schaub)			3			3
Hydryphantes hellichi Thon			1			1
Hydryphantes peroviensis? Udazl.			2			2
Hydryphantes placationis Thon			3			3
Hydryphantes planus Thon			24	4	1	29
Hydryphantes ruber (Geer)		1	6	13		20
Hydryphantes tenuipalpis Thon			1			1
Hydryphantes sp. (deutonymphs)	1	1	23	23	4	52
Thyas pachystoma Koen.					3	3
Thyas sp. (dutonymhs)				3		3
Parathyas thoracata (Piers.)					4	4
Thyasides dentatus (Thor.)			1			1
Hydrodroma despiciens (Müll.)			206			206
Sperchon setiger Thor		1				1
Lebertia insignis Neum.		1				1
Lebertia shadini Sok.	2		1			3
Limnesia connata Koen.			9			9

1	2	3	4	5	6	7
Limnesia fulgida Koch			68	1		69
Limnesia maculata (Müll.)			50			50
Limnesia sp. (deutonymhs)			18			18
Hygrobates calliger Piers.	1	1			1	3
Hygrobates fluviatilis (Ström)		1				1
Hygrobates longipalpis (Herm.)		2			1	3
Atractides nodipalpis (Thor)		3			1	4
Atractides ovalis Koen.		1			1	2
Unionicola crassipes (Müll.)			7			7
Unionicola figuralis (Koch)			2			2
Unionicola gracilipalpis (Viets)			1			1
Neumania deltoides (Piers.)			3			3
Neumania limosa (Koch)			1			1
Neumania vernalis (Müll.)			25			25
Piona alpicola (Neum.)			11			11
Piona clavicornis (Müll.)			10	1		11
Piona coccinea (Koch)			17			17
Piona conglobata (Koch)			1			1
Piona longipalpis (Krend.)			6			6
Piona nodata (Müll.)			58	1	1	60
Piona variabilis (Koch)			38			38
Piona sp. (deutonymphs)			7			7
Hydrochoreutes krameri Piers.			1			1
Tiphys ornatus Koch			139	28		167
Tiphys sp. (deutonymphs)			2			2
Pionopsis lutescens (Herm.)			25	1		26
Brachypoda versicolor (Müll.)			29			29
Mideopsis crassipes Soar		1				1
Mideopsis orbicularis (Müll.)	1					1
Mideopsis roztoczensis	1					1
Arrenurus albator (Müll.)			5			5
Arrenurus batillifer Koen.			22	1		23
Arrenurus bicuspidator Berl.			9			9
Arrenurus bifidicodulus Piers.			111			111
Arrenurus bruzelii Koen.	1		8			9
Arrenurus crassicaudatus Kram.			2			2
Arrenurus cuspidator (Müll.)			4			4
Arrenurus globator (Müll.)			25			25
Arrenurus latus Barr. et Mon.			8			8
Arrenurus maculator (Müll.)			3			3
Arrenurus papillator (Müll.)			1			1
Arrenurus pugionifer? Koen.			1			1
Arrenurus sinuator (Müll.)			1			1
Arrenurus tricuspidator (Müll.)			1			1
Arrenurus truncatellus (Müll.)			2			2
Arrenurus tubulator (Müll.)			5			5
Arrenurus sp. (juv.)			3			3
Arrenurus sp. (deutonymphs)			1			1
Total specimens	81	13	1088	80	17	1279
Total species	10	9	59	10	8	

Explanations: A – the Bug River, B – tributaries of the Bug, C – oxbow lakes, D – temporary pools, E – meadow ditches.

(27.1% of all the material collected, 10 species), Arrenuridae (16.7%, 16 species), Hydrodromidae (16.1%, 1 species), Limnesiidae (11.4%, 3 species), Hydryphantidae (9.7%, 11 species), and Eylaidae (9.0%, 6 species). Dominant species (dominance > 5%) were *Hydrodroma despiciens* (16.1%), *Tiphys ornatus* (13.1%), *Arrenurus bifidicodulus* (8.7%), and *Limnesia fulgida* (5.4%).

There were significant differences in the numbers of individuals and species caught and in the domination structure in the various types of water bodies (Tab. 1). In the Bug River *Eylais infundibulifera* was superdominant (62.9%). Fairly numerous, compared to other species, was *Hydrachna globosa* (11.1%). Only isolated specimens of the remaining taxa were caught. In the oxbow lakes the most numerous species were *Hydrodroma despiciens* (18.9%), *Tiphys ornatus* (12.8%), and *Arrenurus bifidicodulus* (10.2%). In the temporary pools the dominants were *Tiphys ornatus* (35.0%), deutonymphs of *Hydryphantes* sp. (28.7%) and *Hydryphantes ruber* (16.6%). In the Bug tributaries and the meadow ditches the number of specimens caught was too small for domination structure to be determined (Tab. 1).

Faunal similarity between different water body types was low, from 1.5% to 16.6%. It was somewhat higher – 30.8 – only between the Bug tributaries and the meadow ditches.

The species caught in the rheocoenosis (the Bug, its tributaries and meadow ditches) were classified in three ecological groups: rheobionts, rheophiles and rheoxenes. Rheoxenes were strongly dominant in the Bug (95.1% of the fauna collected). The proportions of the remaining groups were very low; rheophiles constituted only 3.7% and rheobionts 1.2%. A different pattern was noted in the Bug tributaries, where the most numerous ecological group was the rheobionts (46.1%), followed by the rheophiles (38.5%), with the rheoxenes making up the lowest percentage (15.4%). Rheoxenes were dominant in the ditches (76.5%), while the proportion of rheobionts and rheophiles was 11.7% each.

In the standing water bodies (the oxbow lakes and the temporary pools) the species caught were classified in the following ecological groups [Cichocka 1998]: small water body species, species characteristic of temporary vernal pools, lake species, and tyrphobiontic and tyrphophilic species. Small water body species dominated in the oxbow lakes (68.1% of the material collected). The second most numerous group consisted of vernal species (22.4%), while the proportion of lake species and tyrphobiontic and tyrphophilic species was small, 5.9 and 3.5%, respectively. In the temporary pools only two synecological groups were noted – vernal pool species constituted 57.0% of the water mites caught, while small water body species made up 43.0%.

The highest species diversity was observed in the oxbow lakes – 4.3. Species diversity was much lower in the temporary pools (2.1), and only 1.6 in the Bug River. In the Bug tributaries and meadow ditches the number of specimens caught was too small for proper estimation of species diversity.

DISCUSSION

Thus far no analyses have been conducted in Poland on water mite distribution in large lowland rivers together with water bodies of the river valley (oxbow lakes, temporary pools, meadow ditches) and tributaries which together form a complex system of surface waters in the given area. In comparing the fauna of the Bug River itself with other lowland rivers in Poland in which a rheobiont and rheophile element was highly represented [Biesiadka 1970, Kowalik 1981, Kowalik and Biesiadka 1981, Cichocka 1996a, b], differences in species composition and the strong domination of rheoxenes must be noted. If, however, we limit the comparison to similar rivers, i.e. large, natural lowland rivers, the fauna of the Bug does not differ substantially from data obtained by other authors [Bazan-Strzelecka 1964, Biesiadka 1972, Biesiadka *et al*. 2004]. The significant proportion of rheoxenes in lowland river fauna or in certain habitats is a natural phenomenon, but such distinct domination must be considered an individual characteristic of Bug fauna.

An interesting phenomenon in the Bug fauna was the high occurrence of species of the genus *Eylais*, with distinct domination of one of these, *E. infundibulifera.* Species of the genus *Eylais* are associated with standing water, but their occurrence in rivers, particularly in zones with slow water flow, a muddy bottom and abundant vegetation, is completely natural [Bazan-Strzelecka 1964, 1971, Biesiadka 1970, 1972, Kowalik 1981, Cichocka 1996a, b, Biesiadka *et al*. 2004]. Bazan-Strzelecka [1964] noted six *Eylais* species in the Warta River, while Biesiadka *et al*. [2004] found as many as nine species of this genus in the Niemen. Thus it is possible that a significant proportion of water mites of the genus *Eylais* is typical of large, lowland rivers.

In the Bug River only 10 water mite species were noted, fewer than in other, similar rivers [Bazan-Strzelecka 1964, Biesiadka *et al.* 2004]. The small number of species was probably due to the homogeneity of the habitats where the water mites were caught (in the zone near the shore of the river with slow water flow, a muddy bottom and moderate vegetation), but the impoverishment of the fauna was probably also influenced by the high level of pollution – on the stretch studied the water of the Bug did not meet quality standards [WIOŚ... 2007]. Water mites are known to be very sensitive to water pollution, and the first to be eliminated are rheobiontic and rheophilic species. Thus the small number of species and the clear domination of rheoxenes in the Bug fauna is the combined result of habitat conditions and water quality.

In general, the fauna of the Bug and its relation to other water bodies of the catchment area are very similar to the fauna of the Niemen. Biesiadka *et al.* [2004] found that the fauna of the Niemen was both qualitatively and quantitatively poor compared to other water bodies of its catchment area, and was characterised by qualitative and quantitative dominance of rheoxenes.

Oxbow lakes are water bodies not often included in research on water mites. Kowalik [1980] caught 227 water mite specimens belonging to 32 species in ten oxbow lakes of the Lublin region. Kowalik *et al.* [2002] report 43 species from oxbow lakes of the Belarusian part of Polesie. The fact that 1.088 Hydrachnidia specimens belonging to 59 species were caught in six oxbow lakes of the Bug River valley indicates that this area plays an important role in shaping and maintaining Hydrachnidia species diversity in this type of water body.

Due to the limnological features of the oxbow lakes of this study and their situation in the valley of a long, natural lowland river, it is more useful to compare them with the oxbow lakes of the Niemen valley. In both cases, of all the types of water bodies studied the most species were caught in the oxbow lakes. Biesiadka *et al.* [2004] found that a characteristic feature of the catchment area of the middle stretch of the Niemen is the secondary significance of the river itself for water mite fauna; other water bodies, including oxbow lakes, are much more significant. The species caught in the oxbow lakes constituted 56.2% of all species noted in the Niemen valley [Biesiadka *et al.* 2004]. In the oxbow lakes of the Bug this indicator was considerably higher, at 83.1%. The Shannon-Wiener species diversity index in the oxbow lakes of the Bug valley was the highest of all the types of water bodies studied, at 4.29. Based on these data it can be stated that oxbow lakes are the key habitats shaping the biological diversity of the Bug River valley. Studies by other authors [Bazan-Strzelecka 1963, Biesiadka 1972, 1974, 1979, Cichocka 1996b, Biesiadka *et al.* 2004] confirm that oxbow lakes play a large, sometimes even dominant, role in shaping the fauna of river valleys. Small water body species dominated the fauna of the Bug oxbow lakes; these usually constitute the most numerous synecological element in this type of water body [Bazan-Strzelecka 1963, Biesiadka 1979, Kowalik 1980, Kowalik *et. al*. 2002, Biesiadka *et al*. 2004].

The most numerous synecological groups in temporary pools are usually vernal species and small water body species, the dominance of one of these elements depending on how astatic the given water body is. Species associated with temporary vernal pools were strongly dominant in the temporary pools of the Bug valley. This was because the water bodies studied were extremely astatic; they dried up shortly after their formation. Dominance of temporary vernal pool species has also been noted in other temporary pools of the Lublin region [Kowalik 1980, Stryjecki 2004, 2006], in other regions of Poland [Biesiadka 1972, Cichocka 1996b], and in water bodies of the Niemen valley [Biesiadka *et al*. 2004].

The water mite fauna of the Bug tributaries was poor in species, but typical of rheocoenoses – rheobionts and rheophiles were dominant. This is in distinct contrast with the fauna of the Bug, where the proportion of rheobiontic and rheophilic species was very small (together 4.9% of the water mites collected). A similar contrast occurred in the Niemen river system [Biesiadka *et al*. 2004] – the Niemen River contained a significant proportion of rheoxenes, whereas rheobionts and rheophiles dominated in its small tributaries.

The fauna of the meadow ditches was a mix of stagnophiles and rheophiles, with stagnobiontic species dominating. Temporary vernal water body species were the dominant element of the fauna. In stretches with fast water flow, rheobiontic and rheophilic species were caught. Vernal species have also been found to dominate in similar biotopes – drainage ditches in Bagna Biebrzańskie wetlands [Cichocka 1996b].

Faunal similarity between the different types of water bodies studied was low, from 1.5 to 16.6%. It was somewhat higher only between the Bug tributaries and the meadow ditches, at 30.8%. Low faunal similarity was noted between the oxbow lakes and the river – only 11.3% – because there was no water connecting the oxbow lakes to the river. Most of the oxbow lakes studied were situated at a considerable distance from the river, and migration of fauna between the river and the oxbow lakes was impossible even when the river flooded in the spring. Whether or not oxbow lakes are connected to the river, the fauna inhabiting them are usually characterised by a certain specificity – they are inhabited by taxa typical of this type of water body which do not occur in other types. This observation has been confirmed in studies by other authors [Bazan-Strzelecka 1963, Biesiadka 1974, Kowalik 1980, Cichocka 1996b, Biesiadka *et al*. 2004]. Low faunal similarity was also noted between the temporary pools and the other types of water bodies in the Bug valley – from 5.0 to 16.6. The highest similarity (16.6) occurred between those water bodies and the oxbow lakes, in which temporary vernal water body species were the second most numerous synecological element. To sum up, it can be stated that the faunal complex studied – the river Bug and the water bodies of its floodplain and catchment area – is characterised by a low degree of integration.

CONCLUSIONS

1. In the fauna of the Bug River, species associated with standing waters were dominant. The small number of species and individuals caught, and the very small proportion of rheobionts and rheophiles, were the result of habitat conditions and the high degree of water pollution.

2. A characteristic feature of the water system studied is the secondary significance of the Bug River for water mite fauna. The key habitats shaping the biological diversity of the Bug valley are its oxbow lakes.

3. Low faunal similarity was found between the different types of water bodies; the faunal complex studied (the Bug River and the water bodies of the floodplain) are characterised by a low degree of integration.

4. The Bug valley can serve as a model of natural ecosystems no longer encountered in Western Europe, and encountered less and less often in Poland. Despite certain changes taking place due to human activity, the Bug River valley represents natural values of European significance.

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WODOPÓJKI (ACARI, HYDRACHNIDIA) DOLINY BUGU
MIĘDZY WŁODAWĄ A KODNIEM

Streszczenie. W dolinie Bugu na odcinku między Włodawą a Kodniem złowiono 71 gatunków wodopójek. W starorzeczach stwierdzono 59 gatunków, w zbiornikach astatycznych 11, w Bugu 10, w dopływach Bugu 9, a w kanałach łąkowych 8. Najliczniejszymi gatunkami były: *Hydrodroma despiciens*, *Tiphys ornatus*, *Arrenurus bifidicodulus* i *Limnesia fulgida*. Charakterystyczną cechą fauny rzeki Bug był dominujący udział reoksenów (95,1% zebranej fauny). W starorzeczach dominowały gatunki drobnozbiornikowe (68,1%) a w zbiornikach astatycznych – gatunki wiosennych wód astatycznych (57,9%). Największą różnorodność gatunkową stwierdzono w starorzeczach (4,3), mniejszą w zbiornikach astatycznych (2,1) zaś w Bugu tylko 1,6. Poszczególne rodzaje wód charakteryzowały się dużą indywidualnością fauny – między zbiornikami stwierdzono niskie podobieństwa faunistyczne. Na podstawie uzyskanych danych można stwierdzić, iż kluczowymi siedliskami kształtującymi różnorodność biologiczną doliny Bugu są zbiorniki tarasu zalewowego, głównie starorzecza.

Słowa kluczowe: wodopójki, rzeka Bug, starorzecza, zbiorniki astatyczne, różnorodność gatunkowa