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HABITAT DISTRIBUTION OF WATER MITES (ACARI: HYDRACHNIDIA) IN KOZŁOWIECKI LANDSCAPE PARK

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Summary. Forty-one species of water mites were noted in Kozłowiecki Landscape Park. The dominant species in the material collected were *Thyas barbigera* (44.3%), *Arrenurus sinuator* (10.7%), *Arrenurus crassicaudatus* (7.3%) and *Piona nodata* (6.8%). Considerably more individuals and species were collected in standing water bodies (781 ind., 33 sp.) than in running water bodies (39 ind., 13 sp.). Of the greatest significance for water mites were astatic pools in forested areas and in open areas, as well as fish ponds. The fauna in the rivers and streams was poor, and no water mites at all were found in springs. Human activity in this area leads both to impoverishment of fauna (through habitat degradation) and to its enrichment (by creating new habitats, i.e. fish ponds). Measures to improve water conditions, at least in some parts of the park, could enhance the natural values of this area and increase its importance for water mites.

Key words: water mites, Hydrachnidia, Kozłowiecki Landscape Park, habitat diversity, species diversity, human impact

INTRODUCTION

There are 17 landscape parks in the Lublin voivodeship [Rąkowski 2004]. For many years an inventory programme has been conducted to catalogue the water mites (Acari: Hydrachnidia) of the landscape parks of the Lublin region. The aim of the inventories is to identify the Hydrachnidia communities inhabiting the areas investigated, to conduct a faunistic valorization of the parks, and to evaluate the anthropogenic transformations affecting the fauna. Water mites are organisms that can have wide-ranging applications for assessing the state of the environment, due to their widespread occurrence and their importance as bioindicators [Kowalik and Biesiadka 1981, Biesiadka and Kowalik 1991, Gerecke and Schwoerbel 1991, Van der Hammen and Smit 1996, Di Sabatino *et al*. 2000, Di Sabatino *et al*. 2003, Biesiadka 2008]. Therefore, analysis of Hydrachnidia communities can provide much valuable information on the current state of aquatic biocenoses, as well as potential threats in the future.

In the Lublin region, the Hydrachnidia faunae of the following landscape parks have thus far been characterized: Pojezierze Łęczyńskie Landscape Park [Kowalik and Stryjecki 1999], Nadwieprzański Landscape Park [Kowalik and Stryjecki 1999, 2000a, Stryjecki 2010], Chełmski Landscape Park [Kowalik and Stryjecki 2000b], Kazimierski Landscape Park [Buczyński *et al*. 2003] and Lasy Janowskie Landscape Park [Stryjecki 2002, 2003, 2004a, 2004b, 2004c].

The aim of this study was to present data on the water mite fauna of Kozłowiecki Landscape Park, a region that had not previously been investigated. The study focused on analysing the habitat distribution of water mites in the park. The occurrence of water mites was analysed in running water bodies (rivers, meadow streams, springs) and standing water (fish ponds, astatic pools). A faunistic valorization of the habitats and areas of the park with the greatest natural values in terms of Hydrachnidia fauna was presented. Measures which could enhance the role of this region for water mites were also proposed.

STUDY SITES AND METHODS

A general characterization of Kozłowiecki Landscape Park can be found in a study by Rąkowski (ed.) [2004]. Samples were taken from 16 sites (8 in running water bodies and 8 in standing water bodies). Five groups of habitats were distinguished among the sites:

A – rivers and streams: the river Minina in Stoczek (N: 51°22’53.37”, E: 22°29’51.82”), Dąbrówka (N: 51°24’40.02”, E: 22°29’2.65”), Biadaczka (N: 51°25’16.93”, E: 22°27’4.37”) and Samoklęski (N: 51°25’46.38”, E: 22°26’26.75” – buffer zone of the park); a tributary of the river Parysówka in Majdan Kozłowiecki (N: 51°24’59.85”, E: 22°33’2.32”); a meadow stream in Biadaczka (N: 51°25’15.47”, E: 22°27’2.15”); Krzywa Rzeka (Ciemięga) in Stary Tartak (N: 51°23’59.45”, E: 22°30’57.65”)

B – springs: a group of rheolimnocrene springs in Stoczek (N: 51°22’53.37”, E: 22°29’51.82”)

C – astatic forest pools: in Majdan Kozłowiecki (N: 51°24’30.49”, E: 22°32’55.51”); the pool called Dzikowisko in Majdan Kozłowiecki (N: 51°24’33.34”, E: 22°32’51.42”); a sphagnum pool in Majdan Kozłowiecki (N: 51°24’36.48”, E: 22°33’1.38”)

D – astatic pools in open areas: in Nowy Staw (N: 51°23’16.61”, E: 22°33’44.7”); the pool called Wyręb in Stary Tartak (N: 51°23’48.52”, E: 22°31’47.1”); small pools in the planned Wielosił reserve (N: 51°22’29.17”, E: 22°34’9.49”)

E – fish-breeding ponds: in Samoklęski (N: 51°25’43.4”, E: 22°26’24.64” – buffer zone of the park); Dołki fish ponds in Stary Tartak (N: 51°25’43.4”, E: 22°26’24.64”)

Field research was carried out in 2005. Samples were collected once a month from April to September (6 times). A total of 112 samples were collected. The material was collected with a dip net with 250 µm apertures (semi-quantitative samples). Faunal similarity between habitat groups was calculated according to the Bray-Curtis formula using the software BIODIVERSITY PRO v.2 [McAleece *et al*. 1997]. Species diversity was calculated using the Shannon-Wiener formula (base 2 logarithm). Species nomenclature was applied according to Biesiadka [2008].

RESULTS

In the water bodies investigated, 820 Hydrachnidia individuals (804 adults and 16 deutonymphs) were collected. There were 41 species belonging to 16 genera and 10 families (Tab. 1). The most frequently represented families were Hydryphantidae (50.6% of the material collected, 8 sp.), Arrenuridae (22.8%, 11 sp.) and Pionidae (12.3%, 9 sp.). Superdominance of one species was noted in the material – *Thyas barbigera* constituted as much as 44.3% of the fauna collected. The other dominants (dominance > 5%) were *Arrenurus sinuator* (10.7%), *Arrenurus crassicaudatus* (7.3%) and *Piona nodata* (6.8%).

Substantially more individuals and species were caught in standing water bodies (781 ind., 33 sp.) than in running water (39 ind., 13 sp.) – Tab. 1.

All of the water mites collected from running water bodies were found in rivers and streams (habitat group A), with most of the specimens caught in the river Minina. Isolated specimens were found in the tributary of the river Parysówka, while none at all were noted in Krzywa Rzeka or in the meadow stream in Biadaczka. In general, it can be stated that the fauna of the rivers and streams of the park is quantitatively extremely poor and atypical in terms of species composition, as most of the species noted were stagnobionts, while fauna typical for rheocenoses, which consist of rheobionts and rheophiles, was poor (Tab. 1).

No water mites were found in the springs (habitat group B).

In standing water bodies, the greatest number of individuals – 325 – were caught in astatic forest pools (habitat group C). Superdominance of one species was noted in this type of water body – *Thyas barbigera* constituted as much as 87.1% of the fauna collected here (Tab. 1). The highest species richness (18 species), on the other hand, was noted in astatic pools situated in open areas (habitat group D). In the fish ponds (habitat group E), high numbers of both individuals (258) and species (14) were collected (Tab. 1).

Two clusters were observed in the faunal similarities between habitat groups (Fig. 1). The first cluster included astatic open-area pools and astatic forest pools (37.6% similarity). The second cluster included fish ponds and rivers and streams, but the faunal similarity between these habitat groups was very low (3.5%).

Table 1. Species composition and numbers of water mites collected in the Kozłowiecki Landscape Park

No	Taxon	Running waters			Standing waters			
		A	B	∑	C	D	E	∑
1.	*Hydrachna leegei* Koen.				8			8
2.	*Limnochares aquatica* (L.)						1	1
3.	*Eylais hamata* Koen.	1		1		1		1
-	*Eylais* sp.							
4.	*Hydryphantes crassipalpis* Koen.					1		1
5.	*Hydryphantes hellichi* Thon	1		1				
6.	*Hydryphantes octoporus* Koen.					1		1
7.	*Hydryphantes planus* Thon				9	13		22
8.	*Hydryphantes ruber* (Geer)	2		2	6			6
-	*Hydryphantes* sp. (deutonymphs)				1	1		2
9.	*Thyas barbigera* Viets				283	80		363
10.	*Thyas pachystoma* Koen.					4	1	5
-	*Thyas* sp. (deutonymphs)					1		1
11.	*Euthyas truncata* (Neum.)				10	1		11
12.	*Lebertia fimbriata* Thor	1		1				
13.	*Limnesia maculata* (Müll.)	1		1			28	28
14.	*Limnesia undulatoides* Davids	2		2			10	10
15.	*Hygrobates fluviatilis* (Ström)	1		1				
16.	*Hygrobates longipalpis* (Herm.)	7		7				
17.	*Hygrobates nigromaculatus* Leb.	16		16				
18.	*Unionicola crassipes* (Müll.)						2	2
19.	*Neumania deltoides* (Piers.)						35	35
20.	*Neumania imitata* Koen.	1		1				
21.	*Neumania vernalis* (Müll.)						2	2
22.	*Piona alpicola* (Neum.)					3		3
23.	*Piona clavicornis* (Müll.)					2		2
24.	*Piona coccinea* (Koch)						1	1
25.	*Piona imminuta* (Piers.)	1		1			7	7
26.	*Piona neumani* (Koen.)						3	3
27.	*Piona nodata* (Müll.)				8	48		56
-	*Piona* sp. (deutonymphs)						9	9
28.	*Tiphys latipes* (Müll.)					9		9
20.	*Pionopsis lutescens* (Herm.)					7		7
30.	*Forelia variegator* (Koch)	3		3				
31.	*Arrenurus ablator* (Müll.)						1	1
32.	*Arrenurus batillifer* Koen.					2		2
33.	*Arrenurus bisulcicodulus* Piers.					6		6
34.	*Arrenurus crassicaudatus* Kram.						60	60
35.	*Arrenurus cylindratus* Piers.	1		1				
36.	*Arrenurus inexploratus* Viets					2		2
37.	*Arrenurus integrator* (Müll.)					2		2
38.	*Arrenurus latus* Barr. et Mon.	1		1			8	8
39.	*Arrenurus mediorotundatus* Thor					11		11
40.	*Arrenurus sinuator* (Müll.)						88	88
41.	*Arrenurus truncatellus* (Müll.)					2		2
-	*Arrenurus* sp. (deutonymphs)					1	2	3
	Total specimens	39		39	325	198	258	781
	Total species	13		13	6	18	14	33
H'		2.8		2.8	0.8	2.7	2.6	3.0

Explanations:
A – rivers and streams, B – springs, C – astatic forest pools, D – astatic open-area pools, E – fish ponds

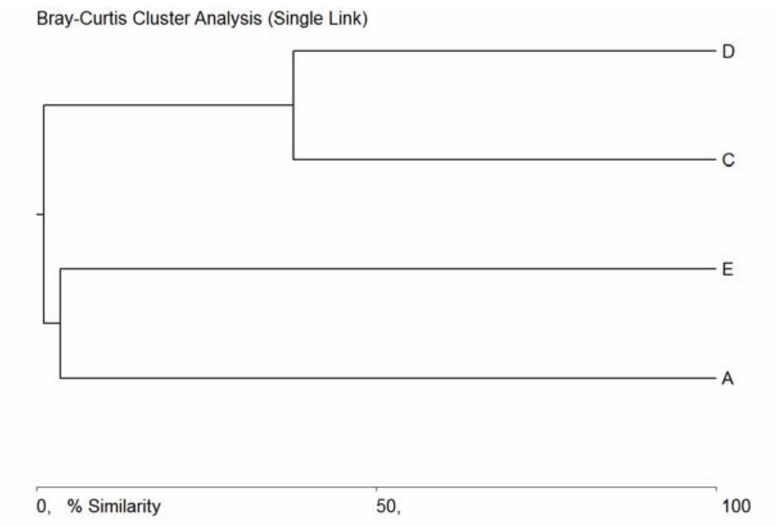

Fig. 1. Faunal similarities between habitats distinguished in the Kozłowiecki Landscape Park: A – rivers and streams, C – astatic forest pools, D – astatic open-area pools, E – fish ponds

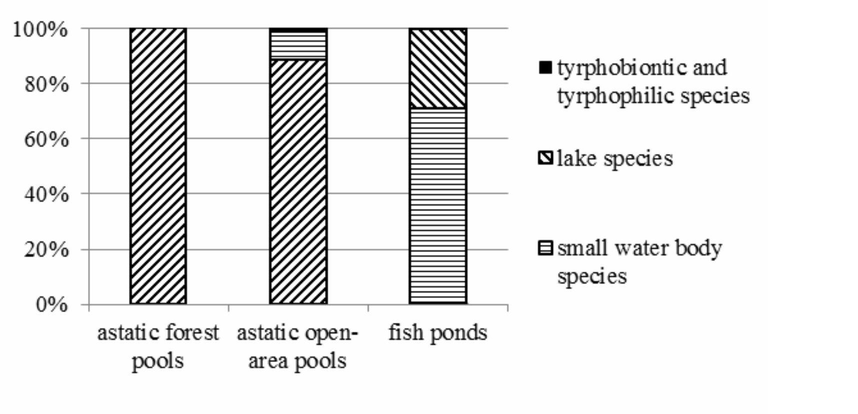

Fig. 2. Percentage share of ecological groups in the standing water bodies of Kozłowiecki Landscape Park

Water mites caught in standing water bodies were classified into four ecological groups according to Cichocka [1998]: small water body species, species typical of vernal astatic water bodies, lake species, and tyrphobiontic and tyrphophilic species. In the astatic forest pools, 100% of the fauna belonged to the group of species characteristic of vernal astatic water bodies. In the astatic pools in open areas, water mites typical of astatic water bodies were dominant (88.2%, 14 sp.), but small water body species were present as well (10.3%, 3 sp.). The fauna of the fish ponds was different, with small water body species dominating (70.4%, 8 sp.) and a substantial proportion of lake species (28.8%, 4 sp.) – Fig. 2.

The nearly complete lack of tyrphobiontic and tyrphophilic species should be considered a characteristic feature of the Hydrachnidia of the park.

Species diversity in the rivers and streams was 2.8. This was also the value for all the running water bodies, as there were no water mites found in the springs. The total species diversity for the standing water bodies was 3.0. Among the standing water bodies, the highest species diversity was noted in the astatic open-area pools (2.7), and the lowest in the astatic forest pools (0.8) – Tab. 1.

DISCUSSION

The number of water mite species noted in Kozłowiecki Landscape Park (41 sp.) is not very high. In contrast, there were 78 species collected from the nearby Nadwieprzański Landscape Park [Kowalik and Stryjecki 1999, 2000a, Stryjecki 2010], 39 species from just one type of water body – peat bog pools – in Chełmski Landscape Park [Kowalik and Stryjecki 2000b], and as many as 148 Hydrachnidia species in Lasy Janowskie Landscape Park [Stryjecki 2002]. The low species richness compared to other landscape parks of the Lublin region may be due to several factors. The water bodies of Kozłowiecki Landscape Park are not very diverse and have been partially transformed by human activity [Buczyński *et al*. 2007]. Due to the low groundwater level and drying out of peat bogs, there are few peat bog pools, particularly permanent ones, while straightening of rivers has reduced the number of small water bodies in their valleys and accelerated their eutrophication. Moreover, when the park was created it included areas that had already been partially transformed by drainage and straightening of rivers [Buczyński *et al*. 2007]. The effect of these factors (unvaried habitats, anthropogenic transformations) is fairly poor Hydrachnidia fauna.

Analysis of the water mite fauna of Kozłowiecki Landscape Park reveals a striking disproportion between running and standing water bodies. The number of study sites in these two types of water bodies was the same (8 in each), but substantially fewer individuals and species were collected from running water bodies (39 ind., 13 sp.) than from standing water bodies (781 ind., 33 sp.). A similar phenomenon was observed in the nearby Nadwieprzański Landscape Park, where there was also a substantial disproportion between the fauna of running and standing water bodies [Stryjecki 2010]. Apart from the surface water network – there are more standing water bodies – the reasons for the impoverished fauna of the running water bodies of Kozłowiecki Landscape Park lie in transformations of the rivers and streams resulting from human activity, i.e. water pollution and hydromorphological changes, such as straightening of river beds and construction of dikes on the banks. These factors unfavourably affect water mites, first eliminating rheobiontic and rheophilic species [Kowalik 1981, Kowalik and Biesiadka 1981, Gerecke and Schwoerbel 1991, Van der Hammen and Smit 1996]. The effect of the anthropogenic transformations of running water bodies in the park was extreme impoverishment of their fauna and its atypical character; most of the species noted in these water bodies were stagnobionts, while the proportion of rheobionts and rheophiles was negligible.

A separate question is the lack of water mites in the springs of the area investigated. The outflow of the rheolimnocrene springs in Stoczek was small; the streams flowing from them were small and shallow. Thus the lack of water mites resulted from poorly developed habitats rather than from other factors. The Kazimierski Landscape Park, which is not geographically distant, has well-developed spring habitats, and here the water mite fauna has been found to be well-developed [Buczyński *et al.* 2003]. It should be added that representatives of other groups of invertebrates have been absent in these springs as well – aquatic beetles [Buczyński *et al.* 2007] and dragonflies [Buczyński 2008].

Among the standing water bodies in the park, the most individuals were noted in the astatic forest pools (325 ind.), while the most species were collected in the astatic pools in open areas (18 sp.). Astatic pools in forests and in open areas created a distinct cluster in the similarity pattern (Fig. 1). A trait shared by these two types of water bodies was a very high proportion of vernal species (Fig. 2). The second similarity cluster consisted of fish ponds and rivers and streams. The grouping of these habitats into one cluster resulted from the fact that the fauna in the rivers and streams was atypical – most of the species noted here were stagnobionts, while fauna typical for rheocenoses, consisting of rheobionts and rheophiles, was poor.

In the astatic water bodies there was very high dominance of one species – *Thyas barbigera*. The proportion of this species was 87.1% in the astatic forest pools, and 40.4% in the astatic pools in open areas. *Thyas barbigera* is a species associated with astatic water bodies [Biesidaka 1972, 2008, Cichocka 2008], so its presence here is natural. What is surprising, however, is the size of the population. This species occurs infrequently in the Lublin region [Kowalik 1984, Stryjecki 2004b], and in many parts of the region it has not been noted at all [Kowalik 1980, Kowalik and Stryjecki 2000a, b, Stryjecki 2009, 2010]. Based on the available literature, the largest population of this species, not only in the Lublin region but in all of Poland, was noted in the Kozłowiecki Forest.

The very high dominance of *Thyas barbigera* in the astatic forest pools resulted in a low value for the species diversity index (only 0.8 – the lowest of all the water body types). According to Odum [1982], low biodiversity is characteristic of unstable biocenoses subject to seasonal or periodic disturbances due to human activity or to nature. A biocenosis reacts to environmental stress with a decrease in the number of infrequently represented species and a simultaneous increase in the dominance of species with high tolerance for stress. The very high dominance of *Thyas barbigera* – a species characteristic of astatic water bodies – accompanied by a small qualitative and quantitative share of other species, was a reaction to the effects of environmental stress, which in this case was the complete drying up of pools in the summer.

In the fish ponds, large numbers of both individuals and species were caught (Tab. 1), and the species diversity of the Hydrachnidia communities was high. As many as 7 species were caught in the fish ponds that were not noted in other types of water bodies. It should be emphasized that despite their anthropogenic origin, the ponds have played a vital role for the Hydrachnidia communities of this area. Fish ponds have also been very important for other groups of invertebrates; very valuable special care species and indicator species of aquatic beetles [Buczyński *et al*. 2007] and dragonflies [Buczyński 2008] have been noted here.

The nearly complete lack of tyrphobiontic and tyrphophilic species should be considered a characteristic feature of the Hydrachnidia of the park. From this synecological group only isolated specimens of *Limnochares aquatica* and *Piona alpicola* were collected. Species associated with peat bog pools did not occur due to the lack of suitable habitats. Some of the water bodies examined had characteristics of peat bog pools (abundant patches of *Sphagnum*, acidic water pH – the sphagnum pool in Majdan Kozłowiecki), but these habitats were too ephemeral, drying out in the summer. Due to this instability they were inhabited by species characteristic of vernal water bodies rather than those associated with peat bog pools. A lack of species associated with peat bog pools has also been noted in the case of other groups of invertebrates, e.g. aquatic beetles. According to Buczyńskiego *et. al*. [2007], the habitat conditions in the peat bog pools of the park are unsuitable for the development of fauna associated with this type of water body, as the pools are too ephemeral and the drying out of the peat bogs too deep, which precludes survival of the dry period in deeper, wetter layers of moss.

CONCLUSIONS

1. The Hydrachnidia fauna of Kozłowiecki Landscape Park is poorer than that of other landscape parks in the Lublin region. This is due to the lack of variety of aquatic habitats as well as to the detrimental effects of human activity.

2. Of greatest significance for the fauna were astatic pools – the greatest number of individuals and species were noted here. The fauna of the rivers and streams was very poor, and no water mites at all were found in the springs.

3. The significance of fish ponds for water mites should be emphasized. These water bodies were an important habitat and increased the species diversity of the fauna of the park.

4. Human activity in the area contributes both to impoverishment of fauna (through habitat degradation) and to its enrichment (by creating new habitats – fish ponds). Taking measures to improve water conditions, at least in some parts of the park, could enhance the nature values of the area and its significance for water mites.

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ROZMIESZCZENIE SIEDLISKOWE WODOPÓJEK (ACARI: HYDRACHNIDIA) W KOZŁOWIECKIM PARKU KRAJOBRAZOWYM

Streszczenie. W Kozłowieckim Parku Krajobrazowym stwierdzono występowanie 41 gatunków wodopójek. W zebranym materiale dominowały: *Thyas barbigera* (44,3%), *Arrenurus sinuator* (10,7%), *Arrenurus crassicaudatus* (7,3%) i *Piona nodata* (6,8%). Znacznie więcej osobników i gatunków złowiono w wodach stojących (781 osobn., 33 gat.) niż w wodach płynących (39 osobn., 13 gat.). Najlepsze warunki dla wodopójek były w zbiornikach astatycznych terenów leśnych, terenów otwartych, oraz w stawie hodowlanym. W rzekach i strumieniach fauna była uboga, w źródłach wodopójek w ogóle nie stwierdzono. Działalność człowieka na tym terenie powoduje jednocześnie zubożenie fauny (poprzez degradację siedlisk), jak i jej wzbogacenie (tworzenie nowych siedlisk – stawów hodowlanych). Podjęcie działań na rzecz poprawy stosunków wodnych, przynajmniej w niektórych częściach Parku, mogłoby się przyczynić do podwyższenia walorów przyrodniczych tego terenu i poprawy warunków dla wodopójek.

Słowa kluczowe: wodopójki, Hydrachnidia, Kozłowiecki Park Krajobrazowy, zróżnicowanie siedliskowe, różnorodność gatunkowa, oddziaływanie antropogeniczne