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Water mites (Acari, Hydrachnidia) in three forest and landscape reserves in Roztocze

Wodopójki (Acari, Hydrachnidia) trzech rezerwatów krajobrazowo-leśnych Roztocza

SUMMARY

The materials of water mites collected in 1973–1974 in aquatic environments of three nature reserves in Roztocze were characterized. The collections comprised 995 Hydrachnidia belonging to 49 species. Twenty-eight species were collected in the Nad Tanwią Reserve, 30 species – in the Czartowe Pole Reserve, and 24 species – in the Szum Reserve. The analyzed reserves cover short river sections, therefore, the evaluated fauna can be regarded as relatively rich. The fauna of the examined reserves included widely distributed species as well as species typical of montane and submontane areas. In the analyzed reserves, the water mite fauna was dominated by rheobionts and rheophiles, and it was characteristic of upland rivers in the Lublin Region. One species new to Poland was identified: *Atractides albaruthenicus* Cich. et Bies. A comparison of the water mite fauna from the Nad Tanwią Reserve with the materials collected in 2001–2002 points to a significant reduction in the number of water mite species and considerable changes in the structure of synecological groups.
Key words: Hydrachnidia, nature reserve, upland river, species diversity.

STRESZCZENIE

Opracowano zbiory wodopójek pochodzące z lat 1973–1974 ze środowisk wodnych trzech rezerwatów Roztocza. Łącznie zebrano 995 osobników Hydrachnidia należących do 49 gatunków. W rezerwacie Nad Tanwią stwierdzono 28 gatunków, w rezerwacie Czartowe Pole 30 gatunków i w rezerwacie Szum 24 gatunki. Ponieważ eksplorowane rezerwaty obejmują krótkie odcinki rzek,

badaną faunę można ocenić jako stosunkowo bogatą. W strukturze faunistycznej, obok gatunków szeroko rozmieszczonych, wyróżniono gatunki górskie i podgórskie. Fauna wodopójek badanych rezerwatów była zdominowana przez reobionty i reofile. Można ją określić jako typową dla rzek wyżynnych Lubelszczyzny. Stwierdzono jeden gatunek nowy dla Polski: *Atractides albaruthenicus* Cich. et Bies. Porównując faunę wodopójek rezerwatu Nad Tanwią z materiałami zebranymi w latach 2001–2002, stwierdzono znaczne zmniejszenie liczby gatunków wodopójek oraz istotne zmiany w strukturze grup synekologicznych.

Słowa kluczowe: Hydrachnidia, rezerwat, rzeka wyżynna, różnorodność gatunkowa

INTRODUCTION

Water mites (Hydrachnidia) in the aquatic ecosystems of Roztocze and the Sandomierz Lowland (south-eastern Poland) were studied in 1973–1974. The majority of biological specimens from those regions have been described in published studies (4, 5, 6, 11, 12, 13, 14, 17). Rich as well as ecologically and regionally diversified fauna of water mites was found. In springs 40 species were caught (11 new for the fauna of Poland), 85 species in streams and rivers (one news for the science – *Mideopsis roztoczensis* Bies. et Kow., 12 rare species for Poland), 57 species in standing waters (7 rare species). Characteristic in water mite fauna of the studies area is the significant contribution of mountain species, especially Carpathian ones in streams and rivers as well as postglacial relicts in springs and astatic waters. This paper analyzes the remaining collections of water mites collected in the rivers and streams of three forest and landscape reserves in Roztocze: Nad Tanwią (Tanew River), Czartowe Pole (Sopot River) and Szum (Szum River).

The objective of this study was to analyze the species composition, quantitative structure and environmental diversity of synecological groups of water mites in the rivers and streams of reserves characterized by unique scenic and natural values.

AREA OF INVESTIGATION

The three investigated reserves of Roztocze – Nad Tanwią near the village of Rebizanty (area of 41.3 ha), Czartowe Pole near Hamernia (63.7 ha), and Szum near Górecko Kościelne (17.0 ha) – are situated in deep valleys of rivers Tanew, Sopot and Szum, outside the Roztocze National Park (Fig. 1). The analyzed reserves are located in the southern boundary zone of Roztocze in water gap areas where rivers and streams resemble mountain springs. River beds feature a series of rock-steps of limestone and sandstone, and stone heaps that create small waterfalls, referred to as rapids. In the Sandomierz Basin, outside the boundary zone of Roztocze, the analyzed rivers resemble lowland watercourses with a moderate or slow current and a sandy bottom. Sopot and Szum are left tributaries of the Tanew River. In the evaluated reserves, deep river valleys are overgrown by alder carr, steep valley slopes are covered by firs, spruces, pines as well as various shrubs and herbaceous plants, including many rare and protected species (9).

The analyzed reserves cover relatively short river sections: Tanew – 3 km, Sopot – 6.3 km, and Szum – 2 km.

Four types of aquatic habitats have been identified:

1. lotic habitats (fast-flowing) streams, depth of 0.2–0.4 m, rapids overgrown with aquatic moss, with boulders and sand underneath;
2. lentic habitats (slow-flowing) – shallow zones of the rivers, near the banks, depth of around 0.2 m, sandy and muddy bottom with detritus; those environments were poorly developed

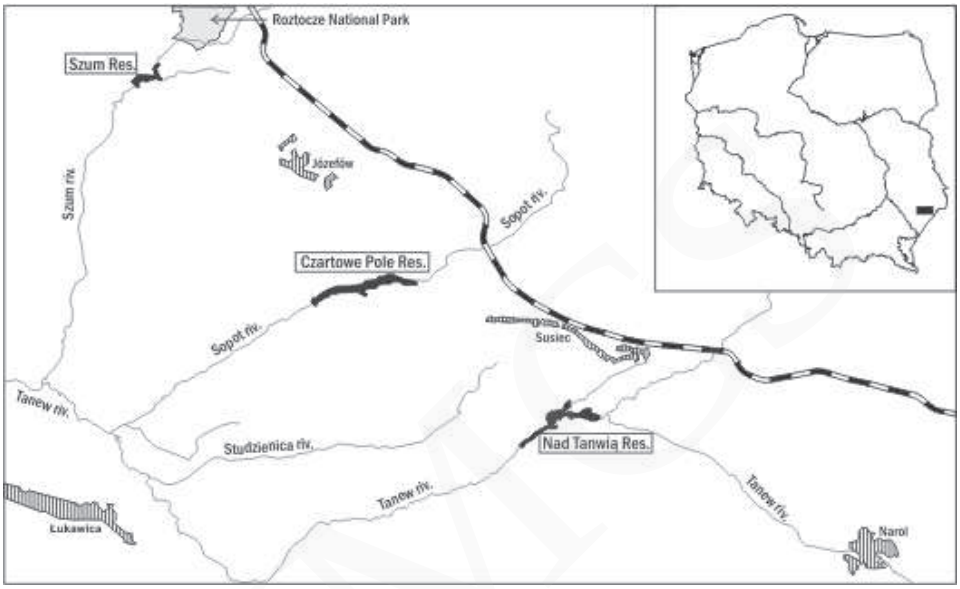


Fig. 1. Area of investigations

in the Czartowe Pole and Szum Reserves which featured numerous springs (rheocrenes and helocrenes).

3. river habitats – river section in the upper part of the reserve with moderate flow rates, depth of 0.4–0,7 m. sandy bottom, local clusters of submerged macrophytes (fluvial environments were not identified in the Szum Reserve);
4. valley springs, slope-food springs and slope-side springs: rheocrenes (sandy or gravel bottom) and helocrenes (muddy and sandy bottom).

MATERIALS AND METHODS

Water mites were collected with a sweep net in four habitats: lotic (fast-flowing) streams, lentic (slow-flowing) streams, river habitats and springs. Water mites colonizing springs had been described in an earlier study (5), and those findings were used in this study as a source of information about the species composition and abundance of water mites in nature reserves. Biological samples were collected three times in each season (spring, summer, fall of 1974). 11 sites were selected for the studies: 4 in each of the nature reserves Nad Tanwią and Czartowe Pole as well as 3 in the Szum nature reserve. 995 water individuals belonging to 49 species were collected. The number of species in the evaluated environments was evaluated in a quantitative analysis. The structure of synecological groups in reserves and habitats, and the dominance of water mites were analyzed. Three dominance classes were identified: eudominant species (D_1) – dominance > 10%, dominant species (D_2) – 4.0–10%, and recedent species (D_3) < 4.0%.

The identified species were classified into synecological groups (3). It should be noted that the ecological characteristics of selected species could be regionally determined.

Samples of river water were collected and subjected to chemical analyses five times in 1974 (March, May, July, September, November) (15). The evaluated rivers were characterized by high

purity, high oxygen concentrations (8.4–14 mg 0_2 /dm^3), high oxygen saturation (60–110%) and pH of 6.5–7.7. Nitrate concentrations and oxidability (3.0–10.6 mg O_2 /dm^3) were low. Magnesium and iron concentrations were low, potassium and calcium levels (19.5–32.0 mg Ca/dm^3) were periodically (July) high.

RESULTS AND DISCUSSION

Water bodies are classified into lowland, upland and mountain categories based on numerous factors, including geographical location, climate, geological structure, slope, type of substrate, water flow rate, water chemistry, fertility levels and purity. Those factors significantly influence the occurrence and diversity of aquatic environments and their fauna, including water mites.

The waters (springs, rivers) of the three evaluated nature reserves were inhabited by 49 water mite species. Twenty-eight species were identified in the Nad Tanwią Reserve, 30 – in the Czartowe Pole Reserve, and 24 – in the Szum Reserve (Table 1). The number of species found in relatively short river sections were similar to those noted in other upland rivers of the Lublin Region: 37 species in Szum, 30 species in Krupiec (14), and 28 species in Bystrzyca Lubelska (10). A long-term study of rivers in the Lublin Region (tributaries of rivers Wieprz and Tanew) revealed 97 water mite species (11). The 49 species identified in the evaluated reserves account for approximately 50% of the total species richness of Hydrachnidia fauna in the Lublin Region, which testifies to their high ecological value.

The following number of water mite species were identified in the analyzed aquatic habitats in nature reserves: 10–18 in lotic habitatas, 8-10 in lentic habitats, 9 and 17 in river habitats (Table 1). Crenophiles were reported in springs and, very rarely, in stream environments: 4 species in the Nad Tanwią Reserve, 11 species in the Czartowe Pole Reserve, and 11 species in the Szum Reserve.

A total of 17 species of crenophiles, 15 species of rheophiles, 13 species of rheobionts and only 4 species of stagnophiles were identified in the waters of the analyzed nature reserves. Low diversity and low abundance of stagnophilic species testify to the high specificity of the evaluated water mite fauna. The following families were most abundant: Hygrobatidae – 723 individuals (72.8% of total abundance, 7 species), Sperchontidae – 149 individuals (15.0%, 9 species) and Lebertidae – 78 individuals (7.8%, 13 species). This structure of water mite families is characteristic of flowing water bodies (1, 3, 11, 14).

NAD TANWIĄ RESERVE

The Nad Tanwią Reserve was colonized mainly by water mites of the family Hygrobatidae, mostly due to very high dominance (292 individuals, 49.6%) of the rheophile *Hygrobates setosus* in river and lentic habitats. *Hygrobates setosus* and

Table 1.Water mites (Hydrachnidia, Acari) of the landscape and forest nature reserves in Roztocze

* – rare species, GS – synecological groups: R – rheobionts, RF – rheophiles, K – crenophiles, SF – stagnophiles, IA – lotic habitats, IB – lentic habitats, II – river habitats, S – total specimens, D% – dominance, z – springs

	Reserve	GS	Nad Tanwią Reserve				Czartowe Pole Reserve				Szum Reserve		
No	Species, Study sites		IA	IB	II	Σ-D%	IA	IB	II	Σ-D%	IA	IB	Σ-D%
1	*Eylais extendens* (O.F.Müll.)	SF				-				-		1	1
2	*Panisus michaeli* Koen.	K*				-	2			2	2		2
3	*P. torrenticolus* Piers.	K*				-				5z			5z
4	*Panisopsis setipes* (Viets)	K*				-				1z			1z
5	*Parathyas palustris* Koen.	K*				-				-			9z-5,5
6	*Protzia eximia* (Protz.)	R				-				-	1		1
7	*Sperchonopsis verrucosa* (Protz.)	R	2			2	1			1	7		7-4,2
8	*Sperchon clupeifer* Piers.	R	3		1	4		2		2			1z
9	*S. compactilis* Koen.	RF	2			2	1			1			-
10	*S. glandulosus* Koen.	RF				-	2			2			-
11	*S. longissimus* Viets	K*				-				-			2z
12	*S. papillosus* Thor	R?	3			3	12	10	12	34-14.2	1		1z
13	*S. setiger* Thor	R	1		25	26-4.3	13	4	11	28-11.7	1		1
14	*S. squamosus* Kram.	K				-			2	2+1z			-
15	*S. thienemanni* Koen.	K				-	2			2+7z			19z-11,6
16	*Lebertia cognata* Koen.	K				-				-			3z
17	*L. dubia* Thor	K			1	1				-			-
18	*L. glabra* Thor	K*	2			2	2			2			-
19	*L. inaequalis* (L.C. Koch)	RF	21	3	2	26-4.4	1	1		2			-
20	*L. insignis* Neum.	RF	1			1				-			-
21	*L. maculosa* Koen.	K*				-	1			1			-
22	*L. natans* Viets	RF				-			1	1			-
23	*L. oblonga* Koen.	RF		1		1z				-			-
24	L. *pilosa* Maglio	RF			1	1							
25	*L. porosa* Thor	RF	4		4	8				-			-

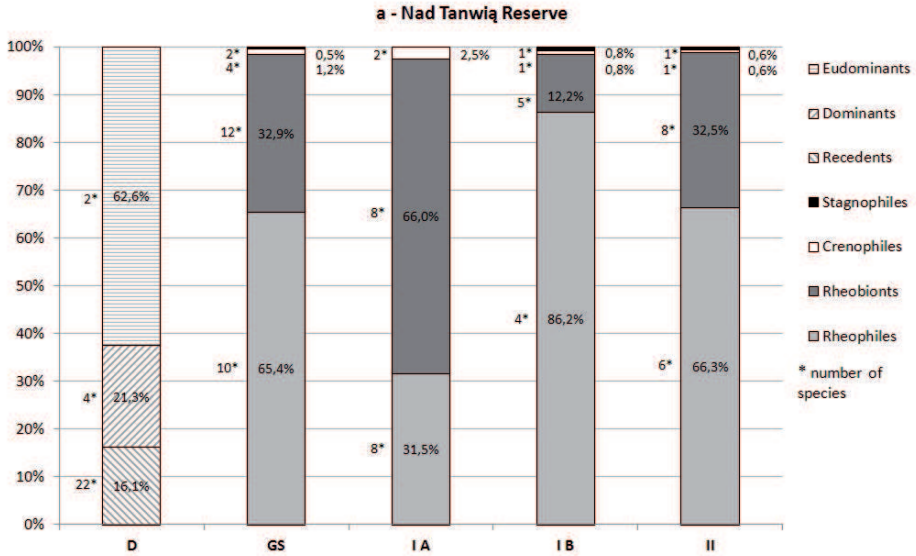
Cont. Table 1.

	Reserve	GS	Nad Tanwią Reserve				Czartowe Pole Reserve				Szum Reserve		
No	Species, Study sites		IA	IB	II	Σ-D%	IA	IB	II	Σ-D%	IA	IB	Σ-D%
26	*L. pusilla* Koen.	R*			2	2				-			-
27	*L. salebrosa* Koen.	K	2			2	6			6			3z
28	*L. stigmatifera* Thor	K				-				12z-5,0			5z
29	*Torrenticola stadleri* (Walt.)	R		2		2				-	2		2
30	*Hygrobates calliger* Piers.	R	40	19	14	73-11.8	13	18	2	33-13,8			-
31	*H. fluviatilis* (Strom)	RF	8		2	10-1.6	3	5	9	17-7,1		2	2
32	*H. longipalpis* Herm.	RF	2		24	26-4.3				-	12	36	48-29,4
33	*H. longiporus* Thor	RF	10		6	16-2.7				-			-
34	*H. norvegicus* (Thor)	K				-				40z-16.8			4z
35	*H. setosus* Bess.	RF	2	216	76	294-49.6		19		19-7.9	7	24	31-18.9
-	*H. sp.* (deutonymphs)	-	3		3	6				-			-
36	*Atractides albaruthenicus* Cich. et	RF*				-	1			1			-
37	Bies.	R	4	2	2	8			2	2			-
38	*A. distans* (Viets)	R	36	7	7	50-8.4	3		3	6			-
39	*A. nodipalpsis* (Thor)	R		1	1	2			1	1	10		10-6,1
40	*A. tener* (Thor)	R?	16			16-2.7	3			3			-
41	*A. sp.* 1	R?			4	4	1			1			-
42	*A. sp.* 2	K?		2		2				-			-
43	*Piona disparilis* (Koen.)	K?				-				-		1	1+1z
44	*Wettina podagrica* (C. L. Koch)	SF		2		2				-			-
45	*Forelia variegator* (C. L. Koch)	SF			1	1				-			-
46	*Brachypoda versicolor* (O. F. Mull)	RF				-				-		1	1
47	*Ljania bipapillata* Thor	RF				-	1			1	2		2
48	*Aturus scaber* Kram.	SF				-		1		1			-
49	*Arrenurus conicus* Piers.	K*				-				1z			-
	A. fontinalis Viets												
	Total specimens		162	255	176	593	68	60	43	238	45	65	164
	Total species		18	10	17	28	18	8	9	30	10	6	24

Hygrobates calliger (73 individuals, 11.8%) were classified as eudominants (combined 62.6% share of the community) (Fig. 2a). The following dominant species were identified (126 individuals, 21.3%, 4 species): *Atractides nodipalpis*, *Sperchon setiger*, *Hygrobates longipalpis* and *Lebertia inaequalis*. The most abundant recedents (93 individuals, 15.8%, 22 species) were: *Hygrobates longiporus*, *H. fluviatilis* and *Atractides* sp. The crenophile *Lebertia glabra* (lotic habitats) and the mountain rheobiont *L. pusilla* (river habitats), both rare in Poland, were also identified. The material collected in the reserve comprised 592 individuals belonging to 28 species. The dominance index was calculated without accounting for six *Hygrobates* sp. deutonymphs.

Water mites were divided into 4 synecological groups: rheobionts, rheophiles, crenophiles and stagnophiles. Species were classified into groups based also on their local characteristics (3).

The Nad Tanwią Reserve was colonized mostly by rheophiles (382 individuals, 65.4% of total abundance, 10 species), and *Hygrobates setosus* was the most abundant species (294 individuals, 49.6%), in particular in spring (March, April), in lentic and river habitats (Table 1, Fig. 2a). The following rheophilic species: *Lebertia inaequalis*, *Hygrobates longipalpis* and *H. longiporus* were also relatively abundant (2.7–4.0% of total abundance). Rheobionts were represented by 12 species and 192 individuals (32.9%), mostly *Hygrobates calliger* (38.0%), *Atractides nodipalpis* (26.0%) and *Sperchon setiger* (13.5%). The proportions of crenophiles (7 individuals, 1.2%, 4 species) and stagnophilic species (3 individuals, 2 species) were very low.



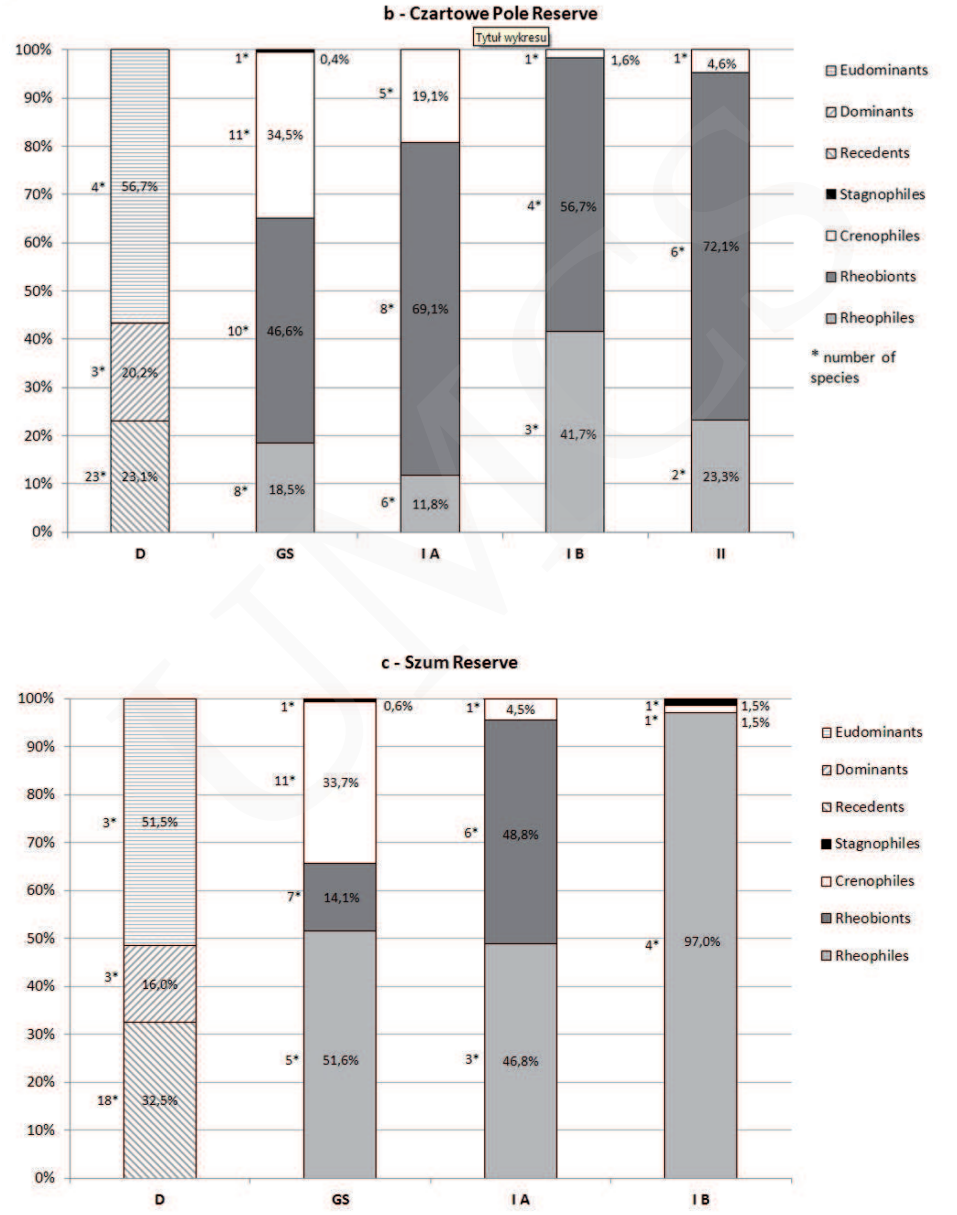


Fig. 2. Dominance structure and abundance of synecological groups of water mites in investigated nature reserves: a – Nad Tanwią Reserve, b – Czartowe Pole Reserve, c – Szum Reserve (D% – dominance, GS – synecological groups, I A – lotic habitats, I B – lentic habitats, II – river habitats)

An analysis of the species composition and abundance of synecological groups of water mites in the four analyzed aquatic habitats of the Nad Tanwią Reserve revealed significant differences (Fig. 2a). Rheobionts were much more abundant in lotic habitats, on rapids and stones (105 individuals, 66.0%, 8 species) than in lentic habitats (31 individuals, 12.2%, 5 species). Rheobionts colonizing rapids were represented mainly by *Hygrobates calliger*, *Atractides nodipalpis* and *A. sp.* Rheophiles inhabiting lotic habitats (50 individuals, 31.5%, 8 species) comprised mostly *Lebertia inaequalis* and *Hygrobates longiporus*. A total of 220 individuals representing 4 species were harvested from lentic habitats with low water-flow rates, where the rheophile – *Hygrobates setosus* was present in great abundance, mainly in spring (216 individuals, 84.7%). Four crenophile were represented by single individuals of *Lebertia glabra* and *L. salebrosa* in lotic habitats, *Piona disparilis* in lentic habitats, and *L. dubia* in the river environment. Stagnophils were sporadically observed in lentic habitats (*Forelia variegator,* 2 individuals) and in the river environment (*Brachypoda versicolor,* 1 individual).

The river environment with a moderate water flow was dominated by rheophiles (114 individuals, 66.3%, 6 species), in particular *Hygrobates setosus* (66.6%) and *H. longipalpis* (21.0%). Rheobionts were less abundant in this environment (56 individuals, 32.5%, 8 species), and were represented mainly by *Sperchon setiger* and *Hygrobates calliger*.

A comparison of water mite fauna harvested in the Nad Tanwią Reserve in 1974 and in 2001–2002 (16) reveals several similarities as well as differences. Faunal richness was significantly reduced from 28 to 17 species. Considerable changes were also noted in the ecological structure of the water mite fauna. In 1974, the abundance of rheophiles was very high (64.5%), and *Hygrobates setosus* was the dominant species (49.6%) in lentic habitats and in the river environment. The proportion of rheobionts was much smaller (32.9%, 12 species), excluding in lotic streams (66.0%, 8 species) (Fig. 2a). In 2001–2002, there was a clear dominance of rheobionts (74.4%, 10 species), in particular in lotic streams and on rapids (16). Rheophiles (32 individuals, 4 species) and crenophiles (45 individuals, 3 species) were least abundant.

In both collections, the same 3 species emerged as dominants: *Hygrobates calliger*, *Atractides nodipalpis* and *Sperchon setiger*. The species that had been represented by single individuals in 1974 (*Lebertia pusilla*, *L. glabra* and *Atractides tener*) were highly abundant in 2001–2002. *Aturus scaber* was not collected in the reserve in 1974, but it was highly common in lotic streams in 2001–2002.

The changes observed in the water mite fauna of the Nad Tanwią Reserve in the course of nearly 30 years are not easy to interpret. A decrease in faunal diversity was noted, mostly with regard to rheophilic species and crenophiles that show a preference for lentic habitats and springs. The above observations could point to changes in habitat conditions. However, the presence of relatively abundant water

mite fauna, dominated by rheobionts, in lentic habitats in 2001–2002 seems to disprove this theory. The high stability of rheobiontic fauna in all analyzed habitats testifies to favorable conditions in the Tanew River in the reserve. The observed changes in the abundance of rheobiontic species could result from periodic fluctuations whose causes remain unknown.

CZARTOWE POLE RESERVE

A total of 238 water mites belonging to 30 species were collected from Czartowe Pole, a reserve characterized by outstanding scenic and natural values (Table 1). The collected material comprised mostly eudominants (135 individuals, 56.9%) (Fig. 2b) represented by 4 species (11.7–16.8%): *Sperchon setiger*, *S. papillosus*, *Hygrobates calliger* and *H. norvegicus* (springs). Three species (48 individuals, 5.0–7.9%) were classified as dominants: *Hygrobates setosus*, *H. fluviatilis* and *Lebertia stigmatifera* (springs). Individually occurring recedents were represented by 23 species and 55 individuals (23.1%). Rheobionts were most abundant (111 individuals, 46.6%, 10 species), with the most populous species of *Sperchon papillosus* (14.2%), *S. setiger* (11.7%) and *Hygrobates calliger* (13.8%). Rheophiles (44 individuals, 18.5%, 8 species) were reported individually, except for *Hygrobates setosus* (7.9%) and *H. fluviatilis* (7.1%). A total of 11 crenophiles (82 individuals, 34.5%) were collected from streams and helocrenes, where the predominant species were *Hygrobates norvegicus* (16.8%) and *Lebertia stigmatifera* (5.0%). Single specimens of 6 crenophile species that are rarely encountered in Poland were also collected: *Panisus michaeli*, *P. torrenticolus*, *Panisopsis setipes*, *Lebertia glabra*, *L. maculosa* and *Arrenurus fontinalis*. *Arrenurus conicus* was the only stagnophil in the reserve.

Lotic streams were inhabited by *Atractides albaruthenicus*, a species that has not been reported from Poland to date. The species, recently described from Belarus, from the Svisloč River (left tributary of the Nemen River) (8), colonizes fast-flowing streams. In Roztocze, *Atractides albaruthenicus* is relatively abundant in the Tanew River in the area of Księżpol and Osuchy (unpublished data).

The percentages of water mite synecological groups varied across the analyzed environments (Fig. 2b). There was a predominance of rheobionts in all environments: lotic habitats (47 individuals, 69.1%, 8 species), lentic habitats (34 individuals, 56.7%, 4 species) and river habitats (31 individuals, 72.1%, 6 species). Relatively abundant rheobiontic species were *Sperchon papillosus*, *S. setiger* and *Hygrobates calliger*. Rheophiles were clearly less abundant, probably due to infrequent and poorly developed backwater pools in stream and river habitats. They were represented by 8 individuals and 5 species in lotic streams, 25 individuals and 3 species in lentic habitats, and 10 individuals and 2 species in river habitats. Crenophilous species which probably originated from numerous

slope-foot springs of the Sopot River, occurred individually in lotic streams (13 individuals, 19.1%, 5 species). One specimen of the stagnophil *Arrenurus conicus* was collected from a lentic habitat, and one specimen of the crenophile *Sperchon squamosus* was harvested from the river.

SZUM RESERVE

The smallest of the analyzed reserves (17 ha) is characterized by a muddy and water-logged river valley, more than ten springs, an absence of a river environment and very poorly developed lentic habitats. The above factors could have contributed to a decline in rheobiont populations and a clear increase in the abundance of crenophiles and rheophilic species (Fig. 2c).

A total of 163 water mites belonging to 24 species, including 5 rare crenophiles: *Panisus michaeli*, *P. torrenticolus*, *Panisopsis setipes*, *Parathyas paulustris* and *Sperchon longissimus* (Table 1), were collected in the Szum Reserve. The eudominants (84 individuals, 51.5%, 3 species) comprised *Hygrobates longipalpis* (29.4%), *H. setosus* (10.4%) and *Sperchon thienemanni* (11.6%). Dominants were weakly represented (23 individuals, 16.0%) by 3 species: *Atractides tener*, *Parathyas palustris* and *Sperchonopsis verrucosa*. In the group of recedents (53 individuals, 32.5%, 18 species), as many as 10 species were crenophiles.

The Szum Reserve was most abundant in rheophiles (84 individuals, 51.6%, 5 species) with the highest share of *Hygrobates longipalpis* (29.4%), and *H. setosus* (18.9%). Crenophiles (55 individuals, 33.7%, 11 species) were also abundant in springs, in particular *Sperchon thienemanni* and *Parathyas palustris* in rheocrenes. In lotic habitat stream the quantitative structure of rheobionts (22 individuals, 48,8%, 6 species) and rheofiles (21 individuals, 46,8%, 3 species) were similar. Lentic habitats were clearly dominated by rheophiles (63 individuals, 97.0%, 4 species) with a significant proportion of *Hygrobates longipalpis* and *H. setosus.* Single specimens of the crenophile *Wettina podagrica* and the stagnophile *Eylais extendens* were also collected.

In the analyzed nature reserves, the water mite fauna of river sections was rich, diverse and characteristic of upland and submontane rivers. Regional specificity was manifested by unique species composition, dominance of rheophiles and rheobionts, and the abundance of crenophiles in the Czartowe Pole and Szum Reserves.

The analyzed region was also inhabited by 8 rare montane or boreal-montane species that are rarely encountered in Poland: *Sperchon glandulosus*, *Lebertia pusilla*, *L. glabra*, *L. maculosa*, *Hygrobates norvegicus*, *Torrenticola stadleri*, *Protzia eximia* and *Arrenurus conicus* (Table 1).

In lotic streams, rapids overgrown with moss were colonized by many rheobiontic species, but fewer rheophiles and crenophiles, which points to a low degree

of moss habitat specificity for water mites. Our findings corroborate the observations made earlier (1, 2).

The species composition and quantitative structure of water mite communities in the analyzed reserve environments are similar to those noted in upland rivers of Roztocze, the Lublin Upland (10, 11, 14, 17) and the Pasłęka River in the Masurian Lakeland (7).

The species diversity of water mite communities determined with the use of the Shannon-Wiener index (H') was highest in the Czartowe Pole Reserve (2.64), somewhat lower in the Szum Reserve (2.52) and lowest in the Nad Tanwią Reserve (1.98). The low value of H in the latter location could be attributed to the superdominance of the rheophilic species of *Hygrobates setosus* (49.6%) which was highly abundant in lentic habitats and in the river environment.

Water mites are highly sensitive to stressors affecting aquatic environments, in particular water pollution (3, 10, 11, 12). In flowing waters, rheobionts are indicator species for habitat quality. In 1973–1974, studies aiming to determine the degree of naturalness and the physicochemical parameters of water in selected springs and rivers of Roztocze revealed environmental diversity and high water quality (15). The water mite fauna in the evaluated nature reserves was characterized by significant richness and different ecological requirements.

REFERENCES

1. Biesiadka E. 1974. Hydracarina of River Raba and some its tributaries. Acta Hydrobiol. 16, 1: 31–50.
2. Biesiadka E. 1979. Wodopójki (Hydracarina) Pienin. Fragm. faun. 24, 4: 97–173.
3. Biesiadka E. 2008. Wodopójki (Hydracarina). [In:] Bogdanowicz W., Chudzicka E., Pilipiuk J., Skibińska E. (eds.). Fauna Polski – charakterystyka i wykaz gatunków. Muzeum i Instytut Zoologii PAN, Warszawa 3: 148–175, 212–219.
4. Biesiadka E., Kowalik W. 1977. Two populations of *Piona disparilis* (Koenike) (Hydrachnellae, Acari) in the springs of Roztocze (Poland). Bull. Acad. Pol. Sci, Cl II, 25: 601–608.
5. Biesiadka E., Kowalik W. 1978. Water mites (*Hydracarina*) of the sources of Roztocze. Acta Hydrobiol. 20: 11–34.
6. Biesiadka E., Kowalik W. 1979. A new species of *Mideopsis* Neuman (Hydrachmellae, Acari) from Poland. Bull. Acad. pol. Sci. Cl. II, 26, 10: 279–298.
7. Cichocka M. 1996. Wodopójki (Hydracarina) rzeki Pasłęki. Fragm. faun. 39, 14: 179–205.
8. Cichocka M., Biesiadka E. 2013. Two species of the genus Atractides Koch, 1837 (Acari: Hydrachnidia, Hygrobatidae) from Belarus. Zootaxa 3808 (4): 253–263.
9. Izdebski K., Grądziel T. 1971. Roztocze. seria Przyroda Polska, PW Wiedza Powszechna, Warszawa, first edition.
10. Kowalik W. 1981. Wodopójki (Hydracarina) rzek dorzecza Wieprza. Ann. UMCS, sec. C 36: 327–352.
11. Kowalik W. 1984. Studia faunistyczno–ekologiczne nad wodopójkami (Hydracarina) południowo–wschodniej Polski. Rozprawy Nauk. Wyd. AR Lublin, 83: 1–67.

12. Kowalik W. 1990. Wpływ zanieczyszczenia wody na faunę wodopójek (Hydracarina) Roztocza. [In:] Badania biologiczne ekosystemów lądowych i wodnych Roztocza i Karpat Wschodnich w warunkach antropopresji. Lubelsko–Lwowska sesja naukowa. UMCS Instytut Biologii, Lwowski Uniw. Państwowy im. Iwana Franko: 149–151.
13. Kowalik W., Biesiadka E. 1978. Nowe i rzadsze w faunie Polski gatunki wodopójek (Hydracarina) z terenu Lubelszczyzny. Przegl. Zool. 22, 1: 31–39.
14. Kowalik W., Zawal A., Buczyńska E. 2014. Water mites (Acari, Hydrachnidia) of the River Szum and Stream Krupiec in the Roztocze Region. Acta Biol. 21:75–89
15. Stępień B., Kowalik W., Radwan S. 1983. Charakterystyka hydrochemiczna rzek dorzecza Tanwi oraz wybranych źródeł dorzecza Wieprza. Ann. UMCS sec. C, 38: 305–322.
16. Stryjecki R., Kowalczyk–Pecka D. 2013. A synecological characterization of the water mite communities (Acari: Hydrachnidia) of the Tanew River in the Nad Tanwią Reserve. Teka Kom. Ochr. Kszt. Środ. Przyr. – OL PAN, 10: 5–13.
17. Zawal A., Kowalik W. 2013. Water mites (Hydrachnidia) of the Biała Łada and Czarna Łada Rivers in the Lublin Region. Ann. UMCS, sec. C 68, 1: 117–125.