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A faunistic and ecological characterization of the water mites (Acari: Hydrachnidia) of the highly anthropologically transformed Mietiulka river in Polesie National Park

Charakterystyka faunistyczno-ekologiczna wodopójek (Acari: Hydrachnidia) silnie przekształconej antropogenicznie rzeki Mietiułka w Poleskim Parku Narodowym

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Słowa kluczowe: Poleski Park Narodowy, wodopójki, Hydrachnidia, ekosystemy rzeczne, oddziaływanie antropogeniczne, renaturalizacja

Abstract
A total of 26 water mite species were found in the Mietiulka River at Polesie National Park. The dominants were *Limnesia fulgida* (35.8%), *Neumania vernalis* (10.6%), *Arrenurus bruzelii* (7.6%), and *A. batillifer* (6.6%). All of the species collected belonged to taxa associated with standing water. Most abundant in the material collected were water mites associated with small pools (73.9%, 12 sp.). Considerably less numerous were vernal species (13.2%, 10 sp.), and tyrphobionts and tyrphophiles (9.4%, 2 sp.), while the proportion of lake species was negligible (3.5%, 2 sp.). The fauna of the Mietiulka river was very similar to the Hydrachnidia communities of standing water bodies in the vicinity. Due to substantial human impact on the river (straightening of the river bed, altered morphometry, hydrological connections with standing water bodies and drainage ditches), species associated with standing water were dominant and there were no taxa typical of river biocenoses. Renaturalization procedures would unquestionably lead to changes in the fauna so that it would be more natural and typical of rivers, with greater proportions of rheobiontic and rheophilic species.

Streszczenie
W rzece Mietiułce w Poleskim Parku Narodowym stwierdzono 26 gatunków wodopójek. Dominantami były: *Limnesia fulgida* (35,8%), *Neumania vernalis* (10,6%), *Arrenurus bruzelii* (7,6%) i *A. batillifer* (6,6%). Wszystkie złowione gatunki należały do taksonów związanych z wodami stojącymi. W zebranym materiale największy udział miały wodopójki drobnozbiornikowe (73,9%, 12 gat.)., znacznie mniej liczne były gatunki fauny wiosennej (13,2%, 10 gat.) oraz *tyrfobionty* i *tyfrofile* (9,4%, 2 gat.), zaś udział gatunków jeziornych był znikomy (3,5%, 2 gatunki). Fauna rzeki Mietiułka wykazywała duże podobieństwo do zgrupowań Hydrachnidia okolicznych zbiorników wód stojących. Efektem silnego oddziaływania antropogenicznego na rzekę (wyprostowanie koryta, zmiana morfometrii rzeki, połączenie hydrologiczne ze zbiornikami wód stojących i kanałami melioracyjnymi), była dominacja gatunków z wód stojących i brak taksonów typowych dla biozenoz rzecznych. Przeprowadzenie zabiegów renaturalizacyjnych z pewnością wpłynęłoby na zmianę fauny w kierunku naturalnym, bardziej rzecznym, z większym udziałem gatunków reobiontycznych i reofilnych.

1. INTRODUCTION

Polesie National Park (PPN), created in 1990, was the first national park in Poland aimed at protecting aquatic, marshy, and peat-bog ecosystems with their unique biocenoses. Apart from natural and semi-natural areas, the park contains ecosystems that have been substantially altered by human impact. This is because when the park was created it included land that had been transformed by many years of human activity. The transformation of Polesie in order to optimize agricultural production had the greatest effect on rivers, which are currently the most highly transformed aquatic habitats in Polesie National Park [Radwan et al. 1993]. All of the rivers in the park flow slowly, have straightened beds, and look like drainage ditches. The course of some rivers has been changed, and they have also become hydrologically connected with standing water bodies, as well as with a dense network of drainage ditches [Michalczyk, Wilgat 1998]. In the 1990s, work was undertaken to renaturalize selected rivers in Polesie [Chmielewski et al. 1996], but these measures were highly localized and did not change the overall character of the river habitats in the park.

The most common form of human impact on river ecosystems is water pollution. The effect of water pollution on water mites has been the subject of research by many authors [Schwoerbel 1959, 1964, Kowalik, Biesiadka 1981, Cicolani, Di Sabatino 1991, Gerecke, Schwoerbel 1991, Böttger, Martin 1995, Van Der Hammen, Smit 1996]. Water pollution has also been reported as the main cause of impoverishment of water mite fauna by Biesiadka [1972, 1974, 1979], Kowalik [1981], and Cichocka [1996]. The results of these studies unequivocally indicate that water mites are very sensitive to water pollution. The best conditions for Hydrachnidia development are found in clean water; pollution leads to a dramatic decrease in the number of species and individuals collected; and in severely polluted water, water mites are not present at all. Moreover, the proportion of rheobionts and rheophiles

decreases, while the proportion of species associated mainly with eutrophic standing water bodies increases.

Apart from water pollution, which is the most important factor reducing the occurrence of water mites, effects that negatively influence Hydrachnidia fauna include changes in the morphology of the river: straightening of river beds, channelization of streams, and changes in bottom structure. These procedures usually lead to impoverishment of water mite fauna, mainly rheophile forms (Biesiadka 1972, Martin 1996, Van Der Hammen, Smit 1996). Nevertheless, there are still few studies describing the problem of hydromorphological transformation of rivers and its effect on water mites.

The aim of this study was to present data on the water mites of the Mietiulka River in Polesie National Park. Thus far there have been no separate studies on the flowing waters of the park; hence research on the Hydrachnidia of the park will be more complete owing to this study. In addition to a faunistic and ecological characterization, the study focuses on characterizing the impact of anthropogenic transformation of the river on Hydrachnidia communities.

2. STUDY SITES AND METHODS

Samples were collected from two sites:

The Mietiulka River in Pieszowola – study site A (N: 51°28'39.28", E: 23°9'46.11"). The upper course of the river. The river has the form of a straight ditch flowing through open terrain. The river bed lies about 1 m below ground surface. The width of the river at this site was 3.5–4.5 m, and its depth was about 1.5 m. There was no visible water flow. Flooded grasses, clusters of *Iris pseudacorus* L., and synanthropic vegetation grew near the banks. About 20% of the water surface was covered with *Lemna minor* L.

The Mietiulka River in Nowiny – study site B (N: 51°27'42.5", E: 23°14'8.62"). This site is located about 5.5 km below the site in Pieszowola. The river has the form of a straight ditch flowing through a forested area and open terrain. The river bed lies about 1.5 m below ground surface. The river was 2.5–3.5 m wide and 0.8 m deep. The bottom was muddy with silty sediment. There was no visible water flow. A thick layer of *Lemna minor* L. covered about 1/3 of the water surface, and in some places the entire width of the river. Sedges, *Acorus calamus* L., *Iris pseudacorus* L., and *Typha latifolia* L. grew near the banks.

The field research was conducted in 2006–2007. Samples were collected once a month, from April to September. The material was collected using a dip net with 250 µm apertures. Samples were collected over a distance of 10 m of the river bank, which with a dip net diameter of 0.25 m gives a total area of 2.5 m^2. Faunal similarity between the study sites and water bodies was calculated according to the Jaccard index. Species diversity was calculated according to the Shannon–Wiener index (base 2 logarithm). Calculations were performed using the software BIODIVERSITY PRO v.2 [McAleece et al. 1997]. Species nomenclature was applied according to Biesiadka [2008], except for the Euthyadine subfamily, for which the nomenclature of Di Sabatino et al. [2010] was used.

3. RESULTS AND DISCUSSION

A total of 302 Hydrachnidia individuals (290 adults and 12 deutonymphs) were collected at the two study sites in the Mietiulka River. These included 26 species belonging to 10 genera and 6 families (Tab. 1). The dominants (dominance > 5 %) were *Limnesia fulgida* (35.8%), *Neumania vernalis* (10.6%), *Arrenurus bruzelii* (7.6%), and *A. batillifer* (6.6%). All of the species collected belonged to taxa associated with standing water.

The 26 species found may seem to be a small number, as 52 water mite species have been noted in the carbonate peat bog pools of the park [Kowalik 1980, 1996, Stryjecki 2010a] and from 34 to 45 species in its lakes [Kowalik, Stryjecki 1999]. It should be emphasized, however, that the data on the water mites of the lakes and peat bog pools were gathered over the last 45 years. If we compare data from the Mietiulka River with other habitats that have also been studied in a two-year cycle, the differences are not so great: 31 water mite species in Bagno Bubnów [Stryjecki 2010a], 36 in small permanent pools [Stryjecki 2011], and 30 in astatic pools [Stryjecki 2012]. For these investigations, material was collected from several different water bodies, which in some cases varied significantly in terms of hydromorphology, whereas the Mietiulka River has highly homogeneous habitats over its entire length. Taking into account the character of the habitats and the high degree of transformation of the river, the 26 species found can probably be considered to be the maximum (or close to the maximum) ecological capacity of this severely anthropogenically altered river.

The water mites collected were classified into four synecological groups: eurytopic species typical of small pools, vernal species associated with astatic pools, lake species, and tyrphobiontic and tyrphophilic species (Tab. 1). Most abundant in the material collected were species associated with small pools (73.9%, 12 sp.). Considerably less numerous were vernal astatic species (13.2%, 10 sp.), and tyrphobionts and tyrphophiles (9.4%, 2 sp.). The proportion of lake species was negligible (3.5%, 2 species).

The complete lack of rheobiontic and rheophilic species, which are usually the dominant component of river fauna, must be considered a characteristic trait of the Hydrachnidia communities of the Mietiulka River. The lack of rheobionts and rheophiles in the Mietiulka River results from the fact that the watercourse can only be included among flowing water bodies due to its typology, while functionally it is similar to a small eutrophic pool. Stagnant water, muddy sediment, and substantial macrophyte overgrowth constitute a habitat in which standing water species, and not those typical of river habitats, find the best conditions for development.

The complete lack of rheobionts and rheophiles in the river was also the consequence of the substantial anthropogenic transformation of the watercourse: straightening of the river bed, changes in its morphometry, and hydrological connections with standing water bodies and drainage ditches in the vicinity. Such a high degree of interference in the river ecosystem is usually detrimental to water mite fauna, causing habitat degradation and impoverishment of fauna; rheophilic and rheobiontic species with a narrow range of tolerance for environmental factors are gradually replaced by species with a wider ecological valence, which are often present in standing water bodies as well [Biesiadka 1972, Martin 1996, Van Der Hammen, Smit 1996].

The water mite fauna of the Mietiulka River was highly similar to the Hydrachnidia communities of standing water bodies in its vicinity. Higher similarity of fauna was noted between the river sites and nearby standing water bodies than between the two river sites: 47% similarity between site B in the river and the Stujło pond in Nowiny, 28% between site A in the river and a small pool in Pieszowola, but only 25% between sites A and B in the Mietiulka River (Fig. 1). Thus the Hydrachnidia fauna of the Mietiulka River can be said to have been influenced to a considerable degree by the standing water bodies in its vicinity. Stagnobiontic water mite species may have entered the river from other water bodies (e.g. fish ponds or drainage ditches) through water connections, but they have also colonized the river independently, carried as larvae by insects (e.g. Odonata).

The absence of river species and the transformation of the biocenoses of the Mietiulka River in the direction of eurytopic fauna characteristic of standing water pertains not only to water mites, but to other groups of invertebrates as well. Buczyński [1997] found that the proportion of rheobionts and rheophiles among the dragonflies of Polesie National Park was marginal, while stagnophilic and eu-

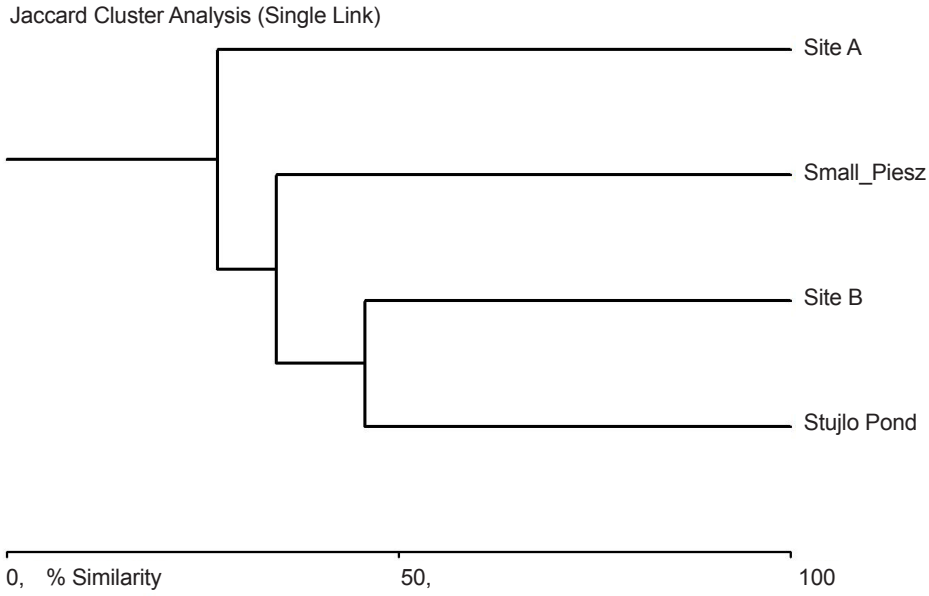

Figure 1. Faunal similarities between study sites in the Mietiulka River and stagnant water bodies situated near these sites.

Explanations:
Site A – Mietiulka River in Pieszowola, Site B – Mietiulka River in Nowiny, Small_Piesz – a small pool in Pieszowola, Stujlo Pond – the Stujło pond in Nowiny.

Table 1. Species composition and numbers of water mites collected in the Mietiulka River at Polesie National Park.

Lp.	Taxon	A	B	∑	SG
-	*Eylais* sp.	-	1	**1**	-
1.	*Hydryphantes helichi* Thon	-	2	**2**	V
-	*Hydryphantes* sp. (deutonymphs)	-	1	**1**	-
2.	*Parathyas pachystoma* Koen.	-	2	**2**	V
3.	*Thyasides dentatus* (Thor)	-	1	**1**	V
4.	*Limnesia fulgida* Koch	54	54	**108**	S
5.	*Limnesia maculata* (Müll.)	-	5	**5**	S
-	*Limnesia* sp. (deutonymphs)	-	1	**1**	-
6.	*Neumania vernalis* (Müll.)	2	30	**32**	S
7.	*Piona alpicola* (Neum.)	13	-	**13**	T
8.	*Piona conglobata* (Koch)	-	1	**1**	S
9.	*Pona neumani* (Koen.)	1	-	**1**	S
10.	*Piona nodata* (Müll.)	-	1	**1**	V
-	*Piona* sp. (deutonymphs)	3	-	**3**	-
11.	*Tiphys ornatus* Koch	14	-	**14**	V
	Tiphys sp. (deutonymphs)	3	-	**3**	-
12.	*Pionopsis lutescens* (Herm.)	2	6	**8**	S
13.	*Arrenurus batillifer* Koen.	6	14	**20**	S
14.	*Arrenurus bifidicodulus* Piers.	9	1	**10**	V
15.	*Arrenurus bruzelii* Koen.	-	23	**23**	S
16.	*Arrenurus crassicaudatus* Kram.	-	1	**1**	L
17.	*Arrenurus fimbriatus* Koen.	14	-	**14**	T
18.	*Arrenurus globator* (Müll.)	-	3	**3**	S
19.	*Arrenurus integrator* (Müll.)	3	-	**3**	V
20.	*Arrenurus knauthei* Koen.	1	-	**1**	V
21.	*Arrenurus latus* Barr. Et Mon.	5	4	**9**	L
22.	*Arrenurus maculator* (Müll.)	-	3	**3**	S
23.	*Arrenurus muelleri* Koen	-	5	**5**	S
24.	*Arrenurus pugionifer* Koen.	1	1	**2**	V
25.	*Arrenurus truncatellus* (Müll.)	2	-	**2**	V
26.	*Arrenurus tubulator* (Müll.)	3	1	**4**	S
-	*Arrenurus* sp.	-	1	**1**	-
-	*Arrenurus* sp. (deutonymphs)	4	-	**4**	-
	Total specimens	**140**	**162**	**302**	-
	Total species	**15**	**19**	**26**	-
	Shannon-Wiener index H’	3.17	3.17	**3.63**	-

Explanations:
Study sites: A – Mietiulka River in Pieszowola, B – Mietiulka River in Nowiny
SG – synecological groups: L – lake species, S – small water bodies species, T – tyrphobiontic and tyrphophilic species, V – vernal species.

rytopic species were dominant. This was due to regulation of watercourses, their eutrophication, and large amounts of suspended solids, as well as the effect of numerous standing water bodies in the area, from which individuals of many dragonfly species migrated and laid eggs in flowing water bodies as well. The caddisfly fauna of the flowing waters of the park, including the Mietiulka river, was most similar to the fauna of the fish ponds [Buczyńska 2013]. Comparing the data on water mites, dragonflies, and caddisflies, it can be concluded that the various groups of invertebrates were affected by the same mechanisms; the atypical species composition of the invertebrates in the flowing waters of the park was the result of anthropogenic transformation of the rivers, but was also due to the character of the landscape, i.e. a surface water network dominated by standing water bodies.

The species diversity of the Hydrachnidia fauna was 3.17 at both site A and site B, while the total in the river was 3.63 (Tab. 1). In other water bodies of PPN the Shannon index was as follows: 4.5 in lake Długie, 4.3 in lake Łukie, 4.1 in lake Moszne [Kowalik, Stryjecki 1999], from 2.88 to 3.72 in small permanent pools [Stryjecki 2011], and from 3.51 to 3.85 in astatic pools [Stryjecki 2012]. Thus despite considerable anthropogenic transformation, habitat homogeneity, and habitat degradation, the species diversity of the Hydrachnidia in the Mietiulka River can be said to be relatively high. Nevertheless, if the watercourse had a more natural character (e.g. if lotic habitats were present), the number of species collected and the species diversity could be expected to be much higher, and the fauna would be more typical of flowing water. Renaturalization procedures would unquestionably lead to changes in the fauna so that it would be more natural and typical of rivers, with significant proportions of rheobiontic and rheophilic species.

4. CONCLUSIONS

1. The Mietiulka River, despite its high degree of anthropogenic transformation, is not a “biodiversity desert”. The number of species collected and the species diversity are comparable to or slightly lower than in other types of water bodies in PPN that were investigated during the same period.
2. The complete lack of rheobiontic and rheophilic species must be considered to be a characteristic trait of the Hydrachnidia communities of the Mietiulka River – all of the species collected belonged to taxa associated with standing water. The atypical faunal composition, with marked dominance of species associated with small pools, resulted from anthropogenic transformation of the river, the habitat conditions prevailing in the watercourse, and the character of the landscape (dominance of standing water bodies in this area).
3. Renaturalization procedures would unquestionably lead to changes in the fauna so that it would be more natural and typical of rivers, with significant proportions of rheobiontic and rheophilic species typical of flowing water biocenoses.

REFERENCES

BIESIADKA E., 1972. Wodopójki (Hydracarina) Wielkopolskiego Parku Narodowego. Pr. monogr. Przyr. Wielkop. Parku Nar. 5: 1-102.

BIESIADKA E. 1974. Hydracarina of the river Raba and some of its tributaries. Acta Hydrobiol. 16: 31-50.

BIESIADKA E. 1979. Wodopójki (Hydracarina) Pienin. Fragm. faun. 24: 97-173.

BIESIADKA E., 2008. Wodopójki (Hydrachnidia). Str. 149-219, w: Fauna Polski – charakterystyka i wykaz gatunków (Bogdanowicz W., Chudzicka E., Pilipiuk I. i Skibińska E., red). Muzeum i Instytut Zoologii PAN, Warszawa, 3, 603 str.

BÖTTGER K., MARTIN P. 1995. Faunistisch-oekologische Studien an den Wassermilben (Hydrachnidia, Acari) dreier kleiner Fliessgewässer des Norddeutschen Tieflandes, unter besonderer Berücksichtigung der rheobionten Arten. Limnologica 25: 61-72.

BUCZYŃSKA E. 2013. Caddisflies (Trichoptera) of the Poleski National Park – state of knowledge, threats and perspectives. [w:] K. Dyguś (ed.), The natural human environment. Dangers, protection, management, education. Wyższa Szkoła Ekologii i Zarządzania, Warszawa (in print).

BUCZYŃSKI P. 1997. Ważki (Odonata) Poleskiego Parku Narodowego. Parki Narodowe i Rezerwaty Przyrody, 16.2: 41-62.

CHMIELEWSKI T. J., HARASIMIUK M., RADWAN S., KARAŚ A. 1996. Ogólne założenia programu renaturalizacji ekosystemów wodno-torfowiskowych w południowo-zachodniej części Pojezierza Łęczyńsko-Włodawskiego. [w:] T. J. Chmielewski, M. Harasimiuk, S. Radwan (red.) Renaturalizacja ekosystemów wodno-torfowiskowych na Pojezierzu-Łęczyńsko-Włodawskim. Wydawn. Petit S.C., Lublin, s. 15-24.

CICHOCKA M. 1996. Wodopójki (Hydracarina) rzeki Pasłęki. Fragm. faun. 39, 14: 179-205.

CICOLANI B., DI SABATINO A. 1991. Sensivity of water mites to water pollution. [in:] F. Dusbabek and V. Bukwa (eds.), Academia Prague. Modern Acarology 1: 465-482.

DI SABATINO A., GERECKE R., GLEDHILL T., SMIT H. 2010. Chelicerata: Acari II. [in:] Gerecke R. (ed.) Süßwasserfauna von Mitteleuropa 7/2-2, pp. 234.

GERECKE R., SCHWOERBEL J. 1991. Water quality and water mites (Acari, Actinedida) in the upper Danube region. [in:] F. Dusbabek and V. Bukwa (eds.), Academia Prague. Modern Acarology 1: 483-491.

KOWALIK W., 1980. Wodopójki (Hydracarina) wód astatycznych Lubelszczyzny. Ann. UMCS, C, 35, 25: 343-364.

KOWALIK W. 1981. Wodopójki (Hydracarina) rzek dorzecza Wieprza. Ann. UMCS, C, 35: 327-351.

KOWALIK W., 1996. Wodopójki (Hydracarina) torfianek kwaśnych i węglanowych Poleskiego Parku Narodowego. [w:] Radwan S. (red.) Funkcjonowanie ekosystemów wodno-błotnych w obszarach chronionych Polesia. Wydaw. UMCS Lublin, s. 123-126.

KOWALIK W., BIESIADKA E. 1981. Occurrence of water mites in the River Wieprz polluted with domestic-industry sewage. Acta Hydrobiol. 23: 331-348.

KOWALIK W., STRYJECKI R. 1999. Zmiany fauny wodopójek (Hydracarina) chronionych zbiorników wodnych Polesia Lubelskiego zachodzące pod wpływem antropopresji. [w:] S. Radwan, R. Kornijów (red.) Problemy aktywnej ochrony ekosystemów wodnych i torfowiskowych w polskich parkach narodowych. Wydaw. UMCS w Lublinie, s. 211-218.

MCALEECE N., LAMBSHEAD P.J.D. , PATERSON G.L.J. 1997. Biodiversity Pro. The Natural History Museum, London.

MARTIN P. 1996. Faunistisch-ökologische Benthosstudien an den Wassermilben (Hydrachnidia, Acari) zweier Bäche des Norddeutschen Tieflandes (Ostholsteinisches Hügelland, Schleswig-Holstein). Faun.-Ökol. Mitt. 7: 153-167.

MICHALCZYK Z., WILGAT T. 1998. Stosunki wodne Lubelszczyzny. Wydaw. UMCS, Lublin ss. 167.

RADWAN S., KARBOWSKI Z., SOŁTYS M. (red.) 1993. Ekosystemy wodne i torfowiskowe na obszarach chronionych. Polskie Towarzystwo Hydrobiologiczne, Akademia Rolnicza w Lublinie, Towarzystwo Wolnej Wszechnicy Polskiej, Poleski Park Narodowy, Lublin.

SCHWOERBEL J. 1959. Ökologische und tiergeographische Untersuchungen über die Milben (Acari, Hydrachnellae) der Quellen und Bäche des südlischen Schwarzwaldes und seiner Randgebiete. Arch. Hydrobiol. Suppl. 24: 385-546.

SCHWOERBEL J. 1964. Die Wassermilben (*Hydrachnellae* und *Limnohalacaridae*) als Indikatoren einer biocönotischen Gliederung von Breg und Brigach sowie der obersten Donau. Arch. Hydrobiol. Suppl. 27: 386-417.

STRYJECKI R., 2010a. Water mites (Acari: Hydrachnidia) of water bodies in the carbonate peat bog Bagno Bubnów in Poleski National Park. Direction and dynamics of changes. Teka Kom. Ochr. Kszt. Środ. Przyr. – OL PAN, 7: 382-388.

STRYJECKI R., 2011. Faunistic and ecological characteristics of the water mites (Acari: Hydrachnidia) of small ponds in Polesie National Park. Teka Kom. Ochr. Kszt. Środ. Przyr. – OL PAN, 8: 202-209.

STRYJECKI R. 2012. Faunistic and ecological characteristics of the water mites (Acari: Hydrachnidia) of astatic pools in Polesie National Park. Teka Kom. Ochr. Kszt. Środ. Przyr. – OL PAN, 9: 215-223.

VAN DER HAMMEN H., SMIT H. 1996. The water mites (Acari: Hydrachnidia) of streams in the Netherlands: distribution and ecological aspects on a regional scale. Netherlands Journal of Aquatic Ecol. 30 (203): 175-185.