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Water mites (Hydracarina) in the branchial cavity of crayfish *Orconectes limosus* (Raf. 1817)

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Abstract – In general, no water mites occurred in the branchial cavities of crayfish found in the River Ina. In the material collected in Lake Ińsko the occurrence of 3 species of the family Limnohalacaridae and 9 of the Hydrachnellae group (extensiveness of 13.54%, intensiveness of 1–15) was determined. The dominant species were *Porohalacarus alpinus* (S. Thor), *Porolohmanella violacea* (Kram.), and *Limnohalacarus wackeri* (Walt.). Differences in the degree of infestation of males and females and a low positive correlation between the body size of infested crayfish individuals and the number of water mites found in them were evidenced. The probability of dependence between the annual number of moultings and the number of water mites colonizing the branchial cavity of a given crayfish was suggested.

Key words: water mites, Halacarae, Limnohalacaridae, crayfish, branchial cavity, parasitism.

1. Introduction

Water mites are a group of free-living animals which in most cases undergo the stage of parasitic larvae. Some of them (e.g. some species of the genus *Unionicola*), have adapted to parasitism also in the stage of imago. The status of water mites colonizing the branchial cavities of freshwater crayfish is not quite clear. The most numerous *Porohalacarus alpinus* (S. Thor) and *Porolohmanella violacea* (Kram.) are free-living species occurring in the psammonic zone of large lakes (Viets 1927, Biesiadka 1972, 1977), treating the branchial cavities of crayfish as an additional environment while *Limnohalacarus wackeri* (Walt) is regarded as a species occurring only in the branchial cavity (Viets 1927).

Hitherto, very little attention has been paid to water mites occurring in the branchial cavity of crayfish. Some observations were reported by Viets (1927), Sokolov (1952), and from the territory of Poland by Wiszniewski (1939). This last author described water mites from the branchial cavity of crayfish species indigenous to Poland (*Astacus astacus* Fabr. and *Potamobius leptodactylus* Eschsch.), but he did not observe their occurrence in the branchial cavity of *Orconectes limnosus* (Raf.) which, as an introduced species, was new to Polish fauna (Gajewski and Terlecki 1956).

The aim of the work was to ascertain the occurrence of astaclidae species in the branchial cavity of *O. limosus* and to calculate the extensiveness and intensiveness of infestation and the correlation between the body size of infested crayfishes and the number of water mites occurring in them. Also differences in the degree of infestation between females and males were investigated and the phenology of astaclidae species was described.

2. Study area

Lake Ińsko (53°26' N, 15°32' E) lies in the River Ina catchment in the Pojezierze Ińskie lake district. It is a vendace lake of 486.6 ha surface area and 41.7 m in maximum depth (Filipiak and Sadowski 1994). It may be classified as lobelia lake (with *Litorella lacustris* L.) of trophic conditions approximating to mesotrophy. In the littoral, wide belts of reeds and submerged aquatic vegetation are divided by sectors of sandy littoral. In the section where the material was collected the River Ina is fairly rapid, about 1.5 m in width and about 1 m in depth. The bottom is sandy with parts overgrown by *Sagittaria sagitifolia* L. and *Elodea canadensis* Rich.

3. Material and methods

Crayfishes were obtained during catches carried out in Lake Ińsko on 4 April, 1 June, and 18 October 1989 by a fish farm, or were taken on 26 July and 26 October 1988 from an eel trap installed about 3 km below the outflow of the river from the lake. A total of 480 crayfishes from Lake Ińsko and 388 from the River Ina were investigated. The collected individuals were measured from the beginning of the rostrum to the end of the abdomen. The branchial cavity was rinsed with a stream of water, then water mites were picked out. A total number of 252 water mites was collected. The extensiveness and intensiveness of infestation were computed for the entire Hydracarina group and for the individual species. Also the correlations between the size of the crayfish body, size of the female body, and size of the male body and the number of water mites found in the branchial cavities were computed. The significance of differences in the infestation of branchial cavities of female and male crayfish by water mites was veryfied using the Man--Whitney U test.

4. Results

Out of 480 individuals of *O. limosus* caught in Lake Ińsko 65 (13.54%) were infested with water mites (Table I). A total of 252 water mites were identified, the number of individuals per one crayfish varying from 1 to 15 (median 2). *P. alpinus* was most numerous (152 ind., extensiveness 11.67%, intensiveness 1–10), followed by *P. violacea* (79 ind., extensiveness 7.50%, intensiveness 1–7) and *L. wackeri* (9 ind., extensiveness 1.46%, intensiveness 1–2). Apart from these single specimens of four other species were found (3 imagines and 1 deutonymph) and four larvae classed into four genera. In the material from the River Ina four crayfishes were infested, this constituting about 1.0% of 388 collected. Two of the water mites found here were classed into two species (imagines), the remaining two were identified only as to genus (larvae).

In samples from Lake Ińsko the greatest numbers of water mites were found in October (215 ind., extensiveness 21.66%, intensiveness 1–15), fewer in June (20 ind., extensiveness 10.30%, intensiveness 1–3) and April (13 ind., extensiveness 1.47%, intensiveness 13) (Table I). The results from April seem somewhat fortuitous, since all the water mites were found in one *O. limosus*. Of two samples from the River Ina water mites were identified only in one collected on 26 July 1988.

Positive correlation was assessed between the body size of all the infested crayfish and the number of water mites found in their branchial cavities (r=0.39) (fig. 1). A coefficient of 0.07 was assessed for the correlation between the body size of infested crayfish females and the number of water mites, the corresponding coefficient for males amounting to 0.55. The distribution of numbers of water mites in the branchial cavities of all the collected crayfish is showed positive skewness with a median of 2 individuals. Using the Mann-Whitney U test a significant difference was evidenced in crayfish infestation as depending on sex, since the number of infested females (25.3%) was double that of infested males (11.7%).

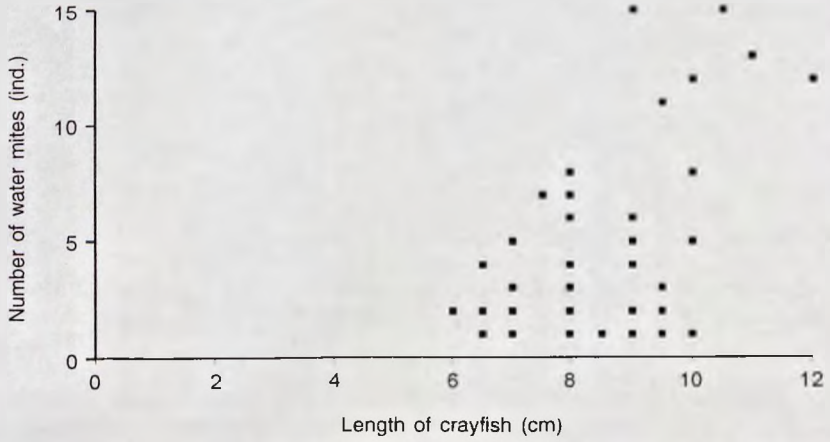

Fig. Relation between the size of *Orconectes limosus* (Raf.) and number of water mites in the branchial cavity.

Table I. Water mites found in branchial cavities of the crayfish *Orconectes limosus* (Raf.): brackets).

Taxa	River Ina			Lake Ińsko		
	26 July 1988			25 April 1989		
	N	E	I	N	E	I
Prolohmannella violacea (Kram.)				1	1 (1.5)	1
Porohalacarus alpinus (S. Thor)	1	1 (0.4)	1	8	1 (1.5)	8
Limnohalacarus wackeri (Walt.)				2	1 (1.5)	2
Limnesia sp. (larvae)				1	1 (1.5)	1
Hydryphantes ruber (de Gerr) (deutonymph)						
Hydrodroma despiciens (Müll.)	1	1 (0.4)	1			
Hygrobates sp. (larvae)	1	1 (0.4)	1	1	1 (1.5)	1
Forelia spatulifera (Marucci)						
Piona sp. (larvae)						
- *rotunda* (Kram.)						
Arrenurus sp. (larvae)	1	1 (0.4)	1			
- *tubulator* (Müll.)						
Total	4	4 (1.8)	1	13	1 (1.5)	13

5. Discussion

Earlier data (Wiszniewski 1939) documented the presence of water mites in the branchial cavities of crayfish species occurring in Poland (*A. astacus* and *P. leptodactylus*) and their absence in the branchial cavity of *O. limosus*. Of the three water mite species characteristic of this habitat *L. wackeri* was found only in the branchial cavity of *A. astacus*, while *P. alpinus* and *P. violecea* were noted both in *A. astacus* and *P. leptodactylus*. It is not known what was the nature of the previous isolation of *O. limnosus* from indigenous astaclidae species (Wiszniewski 1939), though their present occurrence in its branchial cavity suggests that the isolation is being overcome. The absence of astaclidae water mites in the branchial cavity of *O. limosus* was probably due to the fact that in this introduced species the specific water mite fauna had not yet developed. Now the occurrence of the above water mite species also in this crayfish shows its gradual affiliation with indigenous fauna. Additionally the occurrence of all three Limnohalacaridae species in the branchial cavity of this crayfish evidences the penetration of *O. limosus* into habitats characteristic of both *A. astacus* and *P. leptodactylus*.

Of three water mite species of the family Limohalacaridae recorded here, two (*P. alpinus* and *P. violacea*) commonly occur in the psammnic zone of large lakes (Viets 1927), while the habitat of a crayfish branchial cavity is an additional and sometimes substitutive place, where the water mites may survive in spite of unfavourable changes of environmental conditions. This supposition was confirmed by the occurrence of these water mites in Lake Ińsko also outside the branchial cavities of *O. limosus*. On the other hand, the occurrence of the third Limnohalacaridae species, *L. wackeri*, in the branchial cavity gives strong evidence of the close association of *O. limosus* with Polish fauna since, despite its much smaller

N — number of water mites, E — extensivenes (% in brackets), I — intensity (median in

1 June 1989			18 October 1989			Total		
N	E	I	N	E	I	N	E	I
	6 (3.6)	1-2 (1)	71	29 (13.4)	1-7 (2)	79	36 (7.5)	1-7 (2)
	11 (6.7)	1-2 (1)	132	44 (20.3)	1-10 (2)	152	56 (11.7)	1-10 (2)
	1 (0.6)	1	6	5 (2.3)	1-2 (1)	9	7 (1.5)	1-2 (1)
						1	1 (0.2)	1
			1	1 (0.5)	1	1	1 (0.2)	1
						1	1 (0.2)	1
			1	1 (0.5)	1	1	1 (0.2)	1
			1	1 (0.5)	1	1	1 (0.2)	1
7			1	1 (0.5)	1	1	1 (0.2)	1
12			1	1 (0.5)	1	1	1 (0.2)	1
1			1	1 (0.5)	1	1	1 (0.2)	1
20	17 (10.3)	1-3 (1)	215	47 (21.7)	1-15 (3)	252	65 (13.5)	1-15 (2)

numbers, *L. wackeri*, contrary to two other water mites, is regarded as a species occurring only in the branchial cavity of crayfish and is recorded much less frequently (Viets 1927).

The absence of Limnohalacaridae water mites in the material from the River Ina (only one individual of *P. alpinus* was encountered) shows that in general no water mites occur in the branchial cavities of crayfish colonizing a riverine habitat. This is because at least two most numerous species, *P. alpinus* and *P. violacea*, are not associated with running waters.

The phenological pattern of occurrence of astaclidae water mites shows that they were most abundant in October and much less abundant in June and April. The most numerous species, *P. alpinus* and *P. violacea*, decisive in the total numbers of the whole Hydracarina group, are free-living species which occur in lakes (especially *P. violacea*) frequently beeing very abundant. For these species, which are not strict parasites, the role of the branchial cavity of the crayfish is most probably enhanced in the wintering period, bringing about an increase in their numbers in autumn.

In the collected material water mites of Hydrachnellae occurred in very small numbers, appearing only in October (imagines and larvae) and in April (larvae). *P. rotunda*, recorded by Wiszniewski (1939), was also noted in the branchial cavity of *P. leptodactylus* in autumn (November). This shows the substitutive character of this habitat for the above species, which most probably use it chiefly in the winter.

The occurrence of water mite larvae of the genera *Limnesia*, *Hygrobates*, *Piona*, and *Arrenurus* in the branchial cavity of crayfish was an interesting finding. The larvae were obtained from material collected in October and April, i.e. in periods when no larvae usually occur. It is hardly probable that they can pass through the whole developmental cycle there. One should rather regard branchial cavities as

their wintering place. Larvae found in July in the material from the River Ina occurred in an untypical habitat (running waters), therefore in this case the branchial cavity should be considered a substitutive habitat.

The low intensity of infestation (median 2) is striking. The distribution of water mite numbers found in a single crayfish is not a normal one but shows positive skewness, suggesting the occurrence of a factor limiting abundance. This factor is not the size of the crayfish, since the correlation between its body size and the number of recorded water mites was low. Water mites were found in crayfish with a body size of 6 cm and more, the smallest infested individuals being noted in October. Infested crayfishes caught in April and July were larger (8–12 cm). According to Gajewski and Terlecki (1956), *O. limnosus* reaches a length of 6 cm towards the end of the first year of life or during the second year, thus 6-cm individuals caught in October were one year old and after the last moulting. The absence of water mites in the branchial cavities of crayfish individuals of this size in April and July may probably be associated with their intensive growth and moulting in the second year of life. *O. limosus* individuals with a body size of 8 cm or more are 2 years old at least with one (females) or 1–3 (males) moulting periods in the year (Gajewski and Terlecki 1956). All the collected data suggest that the factor limiting the number of water mites occurring in the branchial cavity of a crayfish is the number of moultings in the year.

It is striking that the number of infested females exceeded that of males. Also the coefficients of correlation between the body size of infested females and males and the number of water mites in them are not equal, being greater in males. Most probably the differences may also be interpreted as a dependence between the number of moultings and that of water mites occurring in the branchial cavity of a crayfish. Males moult proportionally to size (the smaller the male, the greater is the annual number of moultings) while adult females (from about 7 cm in length) undergo one moulting in the year. Analysis of these differences shows that for astaclidae Hydracarina the moulting is most likely the critical period when this fauna is partly or completely eliminated. Such a thesis is corroborated by the absence of water mites in crayfish just after moulting (all the collected water mites were derived from crayfish with hard shells).

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