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PARASITIZING ON DAMSELFLIES (ODONATA: COENAGRIONIDAE) BY WATER MITE (ACARI: HYDRACHNIDIA) LARVAE FROM ODESSA PROVINCE (SOUTHWESTERN UKRAINE)

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SYNOPSIS

Five damselfly species (*Ischnura elegans*, *I. pumilio*, *Coenagrion pulchellum*, *Erythromma najas*) from the Odessa province were found with 6 parasitic water mite species (*Hydryphantes octoporus*, *Arrenurus cuspidator*, *A. maculator*, *A. tricuspidator*, *A.* sp.1, *A.* sp.2). The greatest numbers of the larvae were recorded on *Ischnura elegans* and *Coenagrion pulchellum*. Larvae of *Hydryphantes octoporus* were mainly attached to the lateral side of odonata's body while larvae of *Arrenurus* genus were only attached to the ventral side of odonata's body. The preferred parts were mesosternum and metasternum. Larvae two of the parasitic species never been described therefore they are sign as *Arrenurus* sp.1 and *A.* sp.2. The larvae of Hydryphantoidae were recordered first time on odonata's body.

INTRODUCTION

Parasitization of aquatic insects by water mite larvae is very common. Larvae of genus *Arrenurus* are knowing as parasitize Diptera and Odonata, and larvae of *Hydryphantes* up to now are knowing as parasitize only Diptera (Smith, Oliver 1976). There are very few publications from the Ukraine (Pavlyuk 1968; Oliger 1975; Zawal, Dyatlova 2006). This paper, based on the damselflies collected in Odessa province give some new information about parasitization them by *Arrenurus* larvae and the first record of parasitization odonates by *Hydryphantes* larvae.

MATERIALS AND METHODS

Damselflies were collected in the Ukraine: Odessa, Nikolaev and Kherson province in 2004-2006 years. Only infected odonates were considered in the

researches. The materials consist of 112 specimens (81 females and 31 males) of four (*Ischnura elegans* (Vander L.), *I. pumilio* (Charp.), *Coenagrion pulchellum* (Vander L.), *Erythromma najas* (Hansem.)) species; two morphs of *Coenagrion pulchellum* females ("androchrome" and "ginochrome") and one morph of *Ischnura elegans* female ("infuscans").

Larvae of water mites were identified using Zawal (2008) and Tuzovsky (2007) descriptions.

Kruskal-Wallis test was used to checked differences between sizes of larval body.

RESULTS

The damselflies were infected by larvae of 6 water mite species, from which five belong to *Arrenurus* and one to *Hydryphantes* genus (Table 1). Two of larvae of *Arrenurus* never been describing before, therefore they were marked as *Arrenurus* sp.1 and *Arrenurus* sp.2.

Two of the host species (*Ischnura elegans* and *Coenagrion pulchellum*) were more numerous and them were infected more intensity. Both of them include similar number of hosts but intensity of infestation of *C. pulchellum* was higher (Tabel 1).

Among different morphs of odonata females only *C. pulchellum* “gimomorpha” were infected a little smaller, there were no differences between other morphs (Table 1).

The most numerous of parasites was *Arrenurus* sp.1 followed by *A. maculator* (O.F. Müll.), *A. cuspidator* (O.F. Müll.), *A.* sp.2, *Hydryphantes octoporus* Koen.and *Arrenurus tricuspiudator* (O.F. Müll.). *A. maculator* and *A. cuspidator* infected *Coenagrion pulchellum* in higher level than *Ischnura elegans*, *A.* sp.1 and *A.* sp.2 infected in higher level *Ischnura elegans*, and *Hydryphantes octoporus* infected in the same level *Ischnura elegans* and *Erythromma najas* (Table 1).

There are differences in parasitizing sexes in damselflies. Females of *Coenagrion pulchellum* are characterized by both higher prevalence and higher intensity of infestation than males, and females of *Ischnura elegans* are characterized by higher prevalence but lower intensity of infestation than males (Fig. 1).

Parasites preferred metathorax followed by mesothorax, area between wings, I abdominal segment, prothorax and II abdominal segment. Larvae of *Arrenurus maculator* preferred metathorax followed by I abdominal segment, II abdominal segment, mesothorax and prothorax; *A. cuspidator* preferred metathorax followed by mesothorax, prothorax, I abdominal segment and area between wings; *A*. sp.1 preffered area between wings followed by metathorax, mesothorax, prothorax, I abdominal segment and II abdominal segment; *A*. sp.2 preferred mesothorax followed by prothorax, metathorax and area between wings; and finally *Hydryphantes octoporus* preferred area between wings followed by mesothorax (Fig. 2). Most of the larvae of *Arrenurus* genus attached to the ventral side of host body. The only exception is *A.* sp.2 which larvae attached both to the dorsal side (area between

		I. elegans	*I. elegans infuscans*	*I. elegans* total	*I. pumilio*	*C. pulchellum*	*C. pulchellum andromorpha*	*C. pulchellum ginomorpha*	*C. pulchellum* total	*E. najas*	Total
A. maculator	A	18 (0.4)	4 (1.3)	22 (0.4)		142 (7.5)	50 (5.6)	186 (6.2)	377 (13.0)		400
	B	3 (6.4)	1 (33.3)	4 (7.8)		13 (68.4)	7 (77.8)	29 (96.7)	49 (9.8)		53
	C	1-14 (16.7)	4	1-14 (5.5)		1-53 (10.9)	1-22 (7.1)	1-32 (6.4)	1-53 (7.7)		1-53
A. cuspidator	A	8 (0.2)	11 (3.7)	19 (0.4)		124 (6.5)	91 (10.1)	62 (2.1)	277 (4.8)		296
	B	3 (6.3)	3 (100)	6 (11.8)		10 (52.6)	3 (33.3)	12 (40.0)	23 (39.7)		31
	C	1-4 (2.7)	1-7 (3.7)	1-7 (3.2)		1-106 (12.4)	1-87 (30.3)	1-16 (5.2)	1-106 (12.0)		1-106
A. tricuspidator	A	3 (0.1)		3 (0.1)							3
	B	1 (2.1)		1 (2.1)							1
	C	3		3							6
A. sp. 1	A	367 (7.6)	16 (5.3)	383 (7.5)	8	40 (2.1)	6 (0.7)		46 (0.8)	1	438
	B	40 (83.3)	2 (66.7)	42 (82.4)	1 (100)	5 (26.3)	1 (11.1)		6 (10.3)	1 (100)	50
	C	1-44 (9.2)	3-13 (8.0)	1-44 (9.1)	8	1-19 (8.0)	6		1-19 (7.7)	1	1-44
A. sp. 2	A	41 (0.9)		41 (0.9)			5 (55.6)	2 (0.1)	7 (0.1)		48
	B	5 (10.4)		5 (10.4)			1 (11.1)	1 (3.3)	2 (3.4)		7
	C	1-23 (8.2)		1-23 (8.2)			5	2	2-5 (3.5)		1-23
H. octoporus	A	14 (0.3)		14 (0.3)						13	27
	B	3 (6.4)		3 (6.4)						1 (100)	4
	C	1-9 (4.7)		1-9 (4.7)						13	1-13
A. spp.	A	3 (0.1)		3 (0.1)							3
	B	1 (2.1)		1 (2.1)							1
	C	3		3							6
Total	A	454 (9.5)	31 (10.3)	485 (9.5)	8	306 (10.9)	152 (12.7)	250 (5.9)	708 (12.2)	14	1215 (10.8)
	B	48	3	51	1	28	12	42	58	1	112
	C	1-44 (9.5)	7-14 (10.3)	1-44 (9.5)	8	1-72 (10.9)	1-109 (12.7)	1-44 (6.0)	1-109 (12.2)	14	1-109 (10.8)

Table 1. Species composition of parasites and hosts material: A - number of parasites (abundance), B - number of hosts (prevalence), C - intensity of infestation (average)

wings) and ventral side of host body. The larvae of *Hydryphantes octoporus* attached to the dorsal side (between wings) and ventral side mesothorax (Fig. 2). Larvae of *Arrenurus tricuspidator* was found on mesothorax and prothorax. Water mite larvae have also been noted, infrequently, on other parts of body: *A. maculator* – III abdominal segment; *A. cuspidator* – coxa of 2nd legs; *A.* sp.1 – VI and VII abdominal segments, coxa of 2nd legs; *A.* sp.2 – labium.

The body size of parasites varied within 162-1084 um and both the greatest and the smallest individuals belonged to *Hydryphantes octoporus.* The size range of larvae of

the genus *Arrenurus* was 186-596 um (Fig. 3). The Kruskal-Wallis test showed statistically significant differences between the body size of the different parasitic species [H(5,N =1252)=45.837 p=0.0000)] with the reservation that the divergence of *Hydryphantes octoporus* affected the results of the test while larvae of the genus *Arrenurus* species were characterized with similar sizes of their bodies (Fig. 3). The position of the mean and the median (Fig. 3) shows that in the different parasitic species the distributions of the body size of larvae are positively skew, the skewness being particularly distinct in the case of *Hydryphantes octoporus*_and slightly less distinct in the case of *Arrenurus* sp.2.

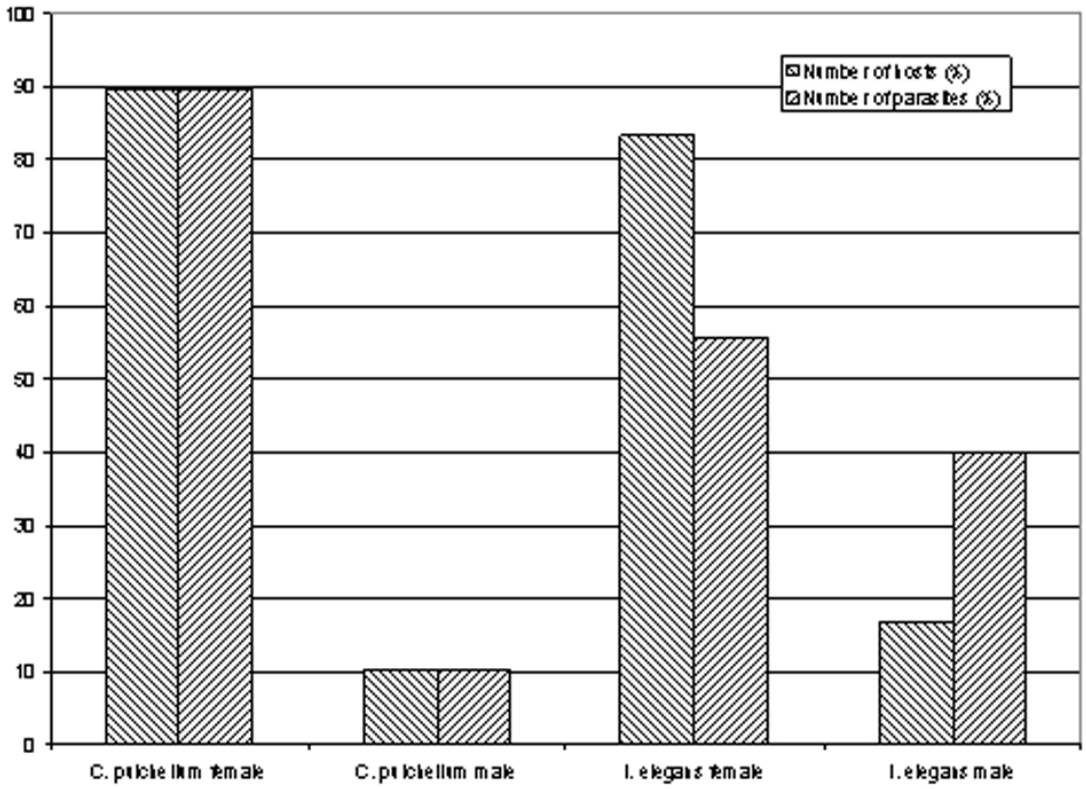

Fig.1. Parasitizing on different sexes.

A. maculator parasitized two host species (Table 1); the size of larvae found on different host species did not statistically differ [H1,N=399)=0.446 p=0.5044)] and their distributions were slightly positively skew (were characterized by a slight positive skewness) (Fig. 4).

A. cuspidator also parasitized two host species (Table 1); the size of larvae occurring on the different host species was statistically significantly different [H(1,N=297)=30.546 p=0.0000)] and the distribution of the size of larvae occurring on *Coenagrion pulchellum* was positively skew and on *Ischnura elegans* negatively skew (Fig. 4).

Arrenurus sp.1 parasitized four species of hosts (Table 1); the size of larvae occurring on different host species were statistically significantly different

[H(3,N=467)=63.187 p=0.0000)] and their distributions were characterized by a light skewness (Fig. 4).

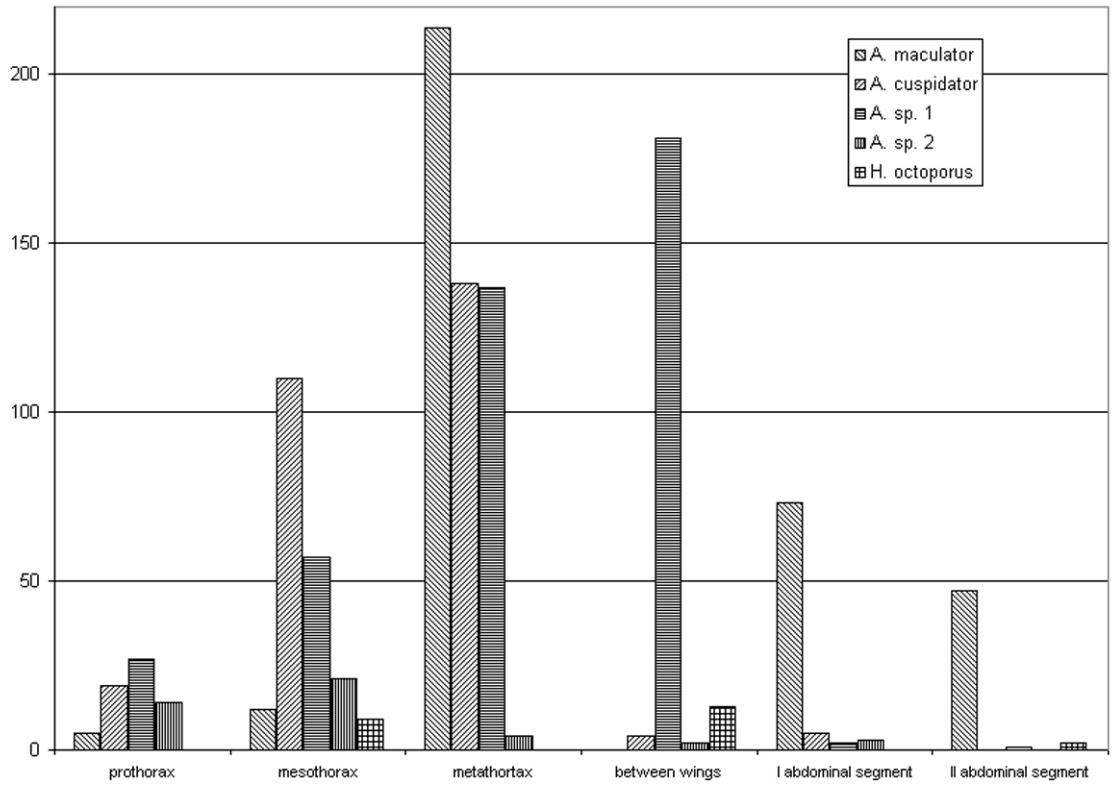

Fig. 2. Number of water mite larvae on particular parts of host body.

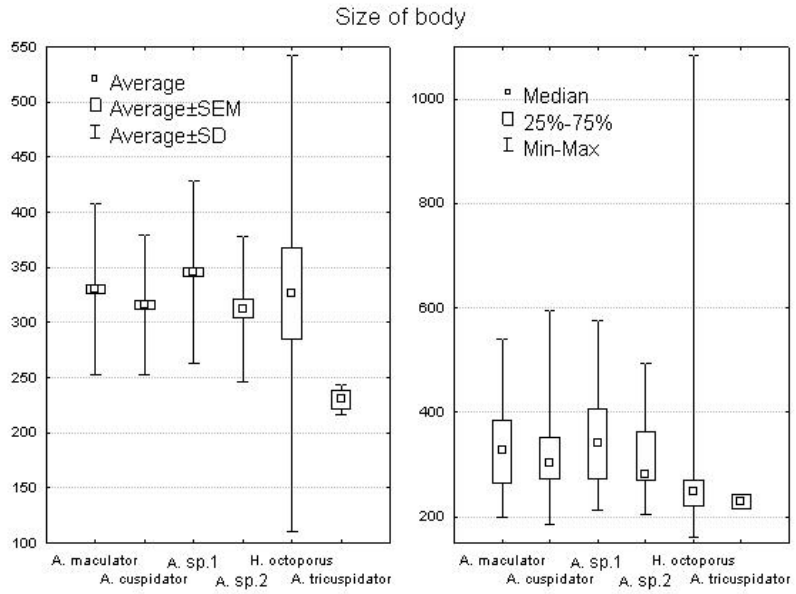

Fig. 3. Body size particular species of water mite larvae.

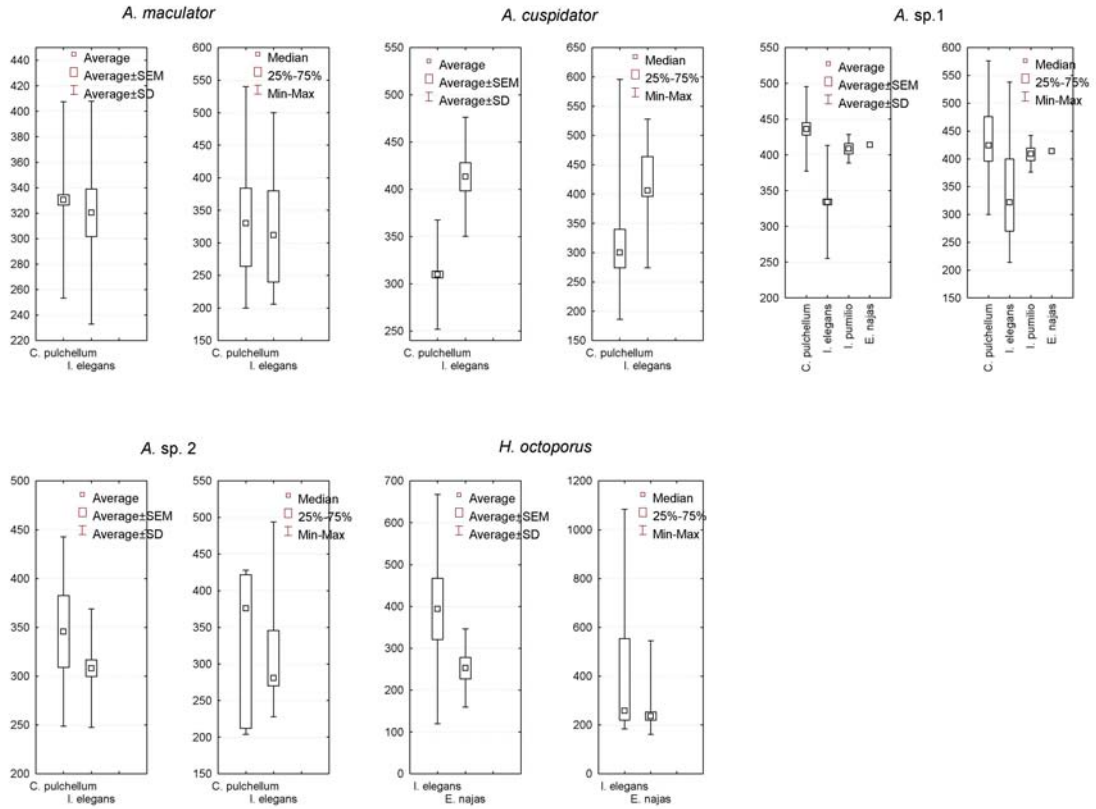

Fig. 4. Body size of parasites occurring on particular host species.

A. sp.2 parasitized two species of hosts (Table 1); the size of larvae on the different host species did not differ statistically [H(1,N=59)=1.294 p=0.2554)]; the distribution of the body size of larvae on *Coenagrion pulchellum* was negatively skew and on *Ischnura elegans* positively skew (Fig. 4).

Hydryphantes octoporus parasitized two species of hosts (Table 1); the size of larvae occurring on different species of hosts did not statistically differ [H(1,N=27)=2.267 p=0.1321)] and their distributions were strongly positively skew (Fig. 4).

The body size of *Arrenurus maculator* larvae occurring on different parts of the body of hosts were statistically significantly different [H(4,N=357)=25.459 p=0.0000)], the main difference being found between the segments of the thorax and the abdomen; the distribution of the body size of larvae found on the prothorax was negatively skew; on the mesothorax and metathorax approximated to the normal and on the segments of abdomen it was positively skew (Fig. 5).

The body size of *A. cuspidator* larvae occurring on different parts of the body of hosts was also statistically significantly differed [H(4,N=277)=22.935 p=0.0001)] owing to the differences between the mesothorax and metathorax and between the mesothorax and the area between bases of wings; the distributions of body sizes of the larvae were slightly positively skew (Fig. 3).

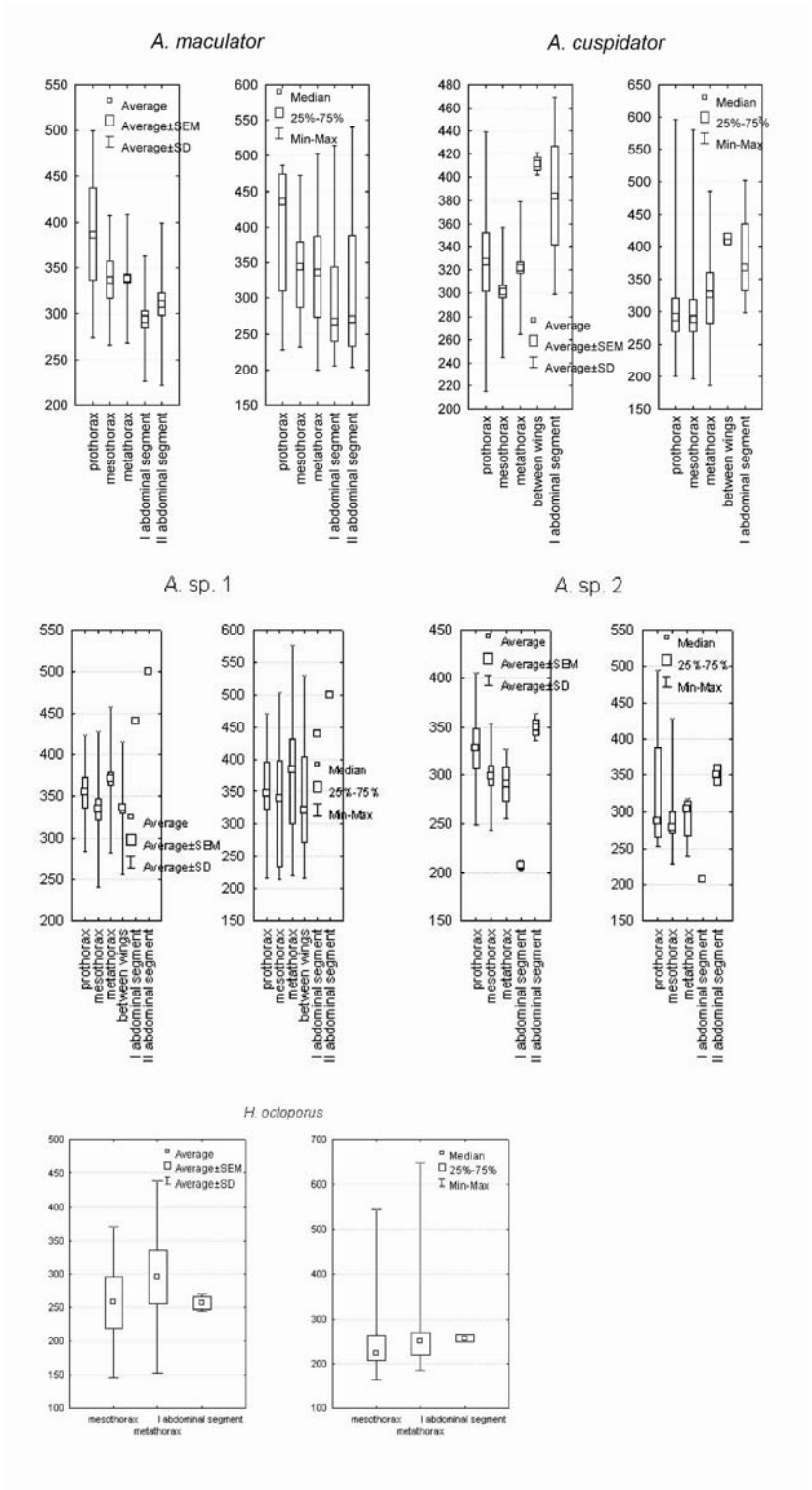

Fig. 5. Body size of parasites occurring on particular parts of host body.

The body size of *A*. sp.1 larvae which occurred on different parts of the host body was statistically significantly different [(H(5,N=414)=18.463 p=0.0024)], the difference being generated by the divergence of the metathorax and the area between the wings; the distributions of the body size of larvae were slightly positively skew (Fig. 5).

The body size of larvae on *A*. sp.2 occurring on different parts of the body of hosts did not statistically differ [H(4,N=53)=8.480 p=0.0755)]; the distribution of the body size of larvae found on the prothorax and mesothorax was positively skew and on the metathorax negatively skew (Fig. 5).

The body size of *Hydryphantes octoporus* larvae occurring on different parts of the body of hosts did not significantly differ from each other [H2,N=24)=1.133 p=0.5676)]; the distributions of the size of the body of larvae were strongly positively skew (Fig. 5).

DISCUSSION

The parasitism of *Arrenurus maculator, A. cuspidator* and *A. tricuspidator* on *Coenagrion pulchellum* and *Ischnura elegans* confirms the information previously reported from the Mediterranean region (Davids 1997). Since the species affiliation of *A.* sp.1 and *A.* sp.2 larvae is unknown, no precise comparisons can be used, however, the fact that *Ischnura pumilio* as a Ponto-Mediterranean species (Devai 1976) was reported only from Ukraine as the host of *Arrenurus* larvae (Pavluk 1968, 1998; Oliger 1975), allows of the suggestion that *A.* sp.1 has not been so far identified at the stage of parasitic larva as the species associated with the Mediterranean region. An additional argument supporting this hypothesis is the preference of this parasitic species for settling on the dorsal side of the host body (between the bases of wings) (Fig. 2), this being an exception among the larvae of the genus *Arrenurus.*

The parasitism of *Hydryphantes octoporus* on dragonflies is very interesting. Up to now all Hydryphantidae were reported as parasites of Diptera (Smith, Oliver 1976); the recorded parasitism on Odonata widens the range of hosts the more so that the very abundant occurrence of this species on two Odonata species (Table 1) excludes the randomness of this phenomenon.

Apart from *Ischnura pumilio* all the remaining three dragonfly species belong to these which are intensively infested by larvae of the genus *Arrenurus* (Zawal 2004, 2006a, b) as it is confirmed by the obtained results (Table 1). *Hydryphantes octoporus* preferred *Ischnura elegans* over *Erythromma najas* (Table 1). In the case of the last species, additionally, all the parasites were found on one host; this maybe suggesting the randomness of the phenomenon and should be verified in further studies.

Preferences of water mite larvae of the genus *Arrenurus* with respect to the sex of the host were discussed in some earlier works (Zawal 2004; Zawal 2006a, b), however, the obtained results did not give unequivocal answers hence the now presented results suggesting the preferences of females (Fig. 1) could have concerned an incidental situation.

The picture of preferences of water mite larvae of the genus *Arrenurus* with respect to the body parts of hosts agrees to a high degree with the previously obtained data (Zawal 2004, 2006 a, b; Baker et al. 2006; Zawal, Dyatlova 2006). The only difference is the absence of *A. cuspidator* larvae which had been found previously on *Ischnura elegans* and *Erythromma najas* (Baker et al. 2006), on middle segments of abdomen.

Analysis of presently and previously obtained data (Baker et al. 2006) gives an interesting picture of preferences of *Arrenurus maculator* and *A. cuspidator* larvae. The two species occur on the same species of hosts and are frequently found on the same host. Both are most frequently found on the metathorax, then on mesothorax and prothorax in the case of *A. cuspidator* and on segments I and II of abdomen in the case of *A. maculator.* This division is clearly visible in the case of occurrence on the same host and can result either from different strategies of infestation or from the competition.

A. sp.2 with its preference for the segments of the thorax (Fig. 2) approximates to the general preferences of larvae of the genus *Arrenurus* (Zawal 2004, 2006a, b; Baker et al. 2006; Zawal, Dyatlova 2006) while *A.* sp.1 is distinctly different with its preference for the area between bases of wings (Fig. 2), this indicating a new species of a parasite so far not identified in the larval form.

Preferences of *Hydryphantes octoporus* are quite different with the preference for the area between bases of wings and for lateral surface of the mesothorax (Fig. 2).

The comparison of the body size of *Arrenurus maculator* and *A. cuspidator* larvae with earlier data (Baker et al. 2008; Zawal 2008) shows that the size of larval bodies found in the present study is slightly larger while the body size of different species is very similar (Fig.3). Differences in the position of the mean and the median (Fig. 3) as well as the skewness of the distributions result from an increased number of individuals of smaller dimensions of the body. In the case of larvae of the genus *Arrenurus* this is due to two overlapping reasons: a part of hosts was caught soon after they were infested hence the small sizes of the parasites; while a part was very intensively infested (Table 1) and because of the scarcity of place increases in the body size were limited in a part of water mite larvae. In the case of *Hydryphantes octoporus*, however, larvae of small and large dimensions were found on separate hosts, this showing different periods of the invasion.

The body size of water mite larvae of the genus *Arrenurus* distinctly depend on the density of larvae on the body of the host. This concerns both different host species (Fig. 4) and different part of the host body (Fig. 5). Like in the case of *A. cuspidator* on *Ischnura elegans* or *Arrenurus* sp.1 on *Ischnura elegans* (fig. 4) larger size of the body is associated with a lower intensity of infestation (Table 1). Similarly like in the case of *Arrenurus cuspidator* found on segment I of the abdomen and *A.* sp.2 on prothorax (Fig. 5) greater size of the body of the parasites is due to their lower density. Most probably differences in the size of *Hydryphantes octoporus* larvae occurring on different host species and different parts of their bodies (Figs 4, 5) are brought about by differences in the period of parasitism, since larvae distinctly differing by their size were always found on different hosts.

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