PARASITISM OF WATER MITE (*HYDRACHNELLAE*) LARVAE OF THE GENUS *EYLAIS* ON WATER BEETLES IN POLAND

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ABSTRACT: In the present work 35150 water beetles of 6 families and 244 species were screened. Water mite larvae of the genus *Eylais* were found on 76 species of beetles of the families Haliplidae, Dytiscidae, Gyrinidae, Hydraenidae, and Hydrophilidae. Twelve *Eylais* species were found, the most numerous of them being *E. longipalpis, E. extendens, E. relicta* (?), *E. setosa, E. muelleri, E. undulosa*, and *E. sp*. The infestation rate was generally low, reaching at maximum 11,9 % of the specimens of species. *E. hamata, E. bisinuosa,* and *E. glubokensis* were found on a single beetle species. The other species are parasites on more than one species, but showed preferences. Larvae were located under the elytra. The size of the larvae varied from 0.13 to 7 mm. The relations between the body size and the data of sampling suggest a prolongation of the reproduction nearly over the entire spring-summer period, or the occurrence of more than one generation during the year. The environmental diversity of parasitism indicates a partial separateness of the infection and parasitism zones, probably due to the extensive mobility of the host.

ZUSAMMENFASSUNG : Für die vorliegende Arbeit wurden 35150 Käfer aus 244 Arten und 6 Familien untersucht. Wassermilbenlarven der Gattung Eylais fanden sich auf 76 Arten der Familien: Haliplidae, Dytiscidae, Gyrinidae, Hydraenidae und Hydrophilidae. Insgesamt 12 Eylais — Arten konnten als Parasiten nachgewiesen werden, darunter als häufigste *E. longipalpis, E. extendens, E. ''cf. relicta''*, *E. setosa, E. muelleri, E. undulosa* und *E. sp.* Die Befallsrate war allgemein gering und erreichte höchstens 11,9 % der Individuen einer Art. *E. hamata, E. bisinuosa* und *E. glubokensis* parasitierten jeweils nur eine Käferart. Die übrigen Parasiten befielen mehr als eine Wirtsart, aber jeweils mit Präferenz für bestimmte Arten. (Diese Bevorzugung könnte auf eine früher andersartige Zusammensetzung des Käferfauna hinweisen). Die Larven fanden sich stets unter den Elythren. Ihre Grösse variierte von 0,13 bis 7,00 mm. Aus des Beziehung zwischen Körpergrösse und zeitlichem Auftreten des Larven kann auf eine über das ganze Frühjahr und Sommer ausgedehnte Reproduktionsperiode geschlossen werden, oder auch auf das Vorhandensein von mehr als einer Generation pro Jahr. Das Verteilungsmuster parasitierter Wirte im Gelände legt nahe, das Zonen des Befalls und des Parasitismus räumlich getrennt sind, wahrscheinlich aufgrund der grossen Beweglichkeit der Wirte.

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Introduction

Few studies are available on the parasitism of water mite larvae on water beetles and the parasitic behaviour of the genus *Eylais* is particulaly badly known. The larvae of this genus are parasites on two orders of insects, taxonomically distant though ecologically allied : Coleoptera and Heteroptera (Piatakov 1915 a, b Lundblad 1927, Sparing 1959, Lanciani 1970, Nielsen & Davids 1975, Davids Nielsen & Gehring 1977, Cichocka 1983, Biesiadka, Cichocka & Zawal 1989, Biesiadka & Cichocka 1994).

This paper deals with the life cycle and host range of 12 species (Table 1.). Of these species, only for three (*E. setosa, E. extendens* and *E. glubokensis*) the parasitism was already discussed in the literature (Cichocka 1983, Davids, Nielsen & Gehring 1977, Lanciani 1970, Nielsen & Davids 1975, Piatakov 1015 b, Sparing 1959).

Mainly due to taxonomic uncertainties, literature data on the ecological distribution of species of the genus *Eylais* are scarce. The revisions proposed by K. O. Viets (1949, 1950) aggregated several different species into one. The studies by Vajstein (1963, 1968, and 1980) showed than that point of view was not correct, and that the genus *Eylais* had more species.

Most water mites of the genus *Eylais* are considered as typical of small water bodies or even eurytopic. *E. extendens, E. undulosa, E. setosa*, and *E. muelleri,* are found in the littoral of lakes more frequently than other species of the genus (Biesiadka & Cichocka 1997, Lundblad 1968, Sokolow 1940). The ecology of *E. longipalpis* is hardly known, chiefly owing to the uncertainty of its taxonomy. Viets (1936) considered it as a subspecies of *E. mutila*. The morphology of *E. longipalpis* larva, however, justifies the separateness of the species. *Eylais koenikei* is regarded as the species of spring astatic waters (Biesiadka 1972). *E. relicta* is a very rare species of the northern distribution range (Lundblad 1968), known in Poland only from Lobelia-type lakes (Biesiadka & Cichocka 1997).

The very few literature data concerning the parasitism of water mites of the genus *Eylais* on water beetles justified the present research. Additionally, the study can supply certain information about the habitat preference of water mites of this genus. The above problems were the basis of the present publication.

Material and methods

The investigation on the parasitism of water mite larvae of the genus *Eylais* on water beetles was conducted on the basis of the same coleopterological material used in former study on Hydrachna larvae on water beetles (Zawal, 2002).

The beetles were examined with the aid of a magnifying glass. Larvae were taken off using preparatory needles, and slide mounted. The water mites were identified according to the Wajnštejn's key (1980).

Two indices were used in descriptive analysis. The infection rate concerns the share of infected individuals in relation to the total number of individuals of a given beetle species, expressed in percentages. The index of the intensity of infection illustrates the number of parasites occurring on one individual of a given host species, expressed by numerical intervals and averages. The computations also includes the correlation coefficients between the numbers of the different host species and the number of infected individuals and between the numbers of the different beetle species and the number of larvae collected on them.

Larvae were divided into three classes of body size: <-0.20 mm, 0.20-1.00 mm, and >2.00 mm. These classes are unequal. The first class (< 0,2 mm) include the young larvae, just after infection. The medium sized larvae included in the second class (0.20-1.00 mm) were characterised by an increase in body size indicating a certain time distance from the infection, though they did not reach the size just before transformation. The third class (>2.00 mm) contained larvae just before moulting. With this arrangement the second interval is characterised by the greatest range and theoretically should contain the greatest number of larvae.

Results

General characteristics of parasitism

A total number of 661 larvae from 12 species was collected. Larvae of two species never described at

Species of parasite	Eylais hamata Koen.			Eylais koenikei Halb.			Eylais setosa Koen.			Eylais extendens (Mull.)			Eylais undulosa Koen.			Eylais tullgreni Thor		
Host species	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Peltodytes caesus (Duft.)										1	1(2,6)	1						
Haliplus confinis Steph.										1	1(1,2)	1						
Haliplus flavicollis Sturm										5	5(2,6)	1						
Haliplus laminatus (Schall.)										1	1(0,4)	1						
Haliplus fluviatilis Aubé										4	4(0,7)	1						
Haliplus immaculatus Gehr.										31	17(0,9)	1-2 (1,8)						
Haliplus lineolatus Mann.										3	3(4,6)	1						
Haliplus ruficollis (Deg.)										8	8(1,0)	1						
Haliplus wehnckei Gehr.										1	1(0,3)	1						
Noterus crassicornis (O.F.Müll.)										10	6(0,2)	1-2 (1,7)						
Hydroporus angustatus Sturm				1	1(0,5)	1				1	1(0,5)	1						
Hydroporus dorsalis (Fabr.)				1	1(1,0)	1												
Hydroporus erythrocephalus (L.)				11	4(5,1)	1-6 (2,8)				1	1(1,3)	1						
Hydroporus palustris (L.)							2	2(0,2)	1	1	1(0,08)	1	1	1(0,1)	1			
Hydroporus striola (Gyll.)										10	4(2,8)	1-7 (2,5)						
Hydroporus umbrosus (Gyll.)				2	2(0,6)	1												
Graptodytes granularis (L.)				1	1(1,7)	1												
Graptodytes pictus (Fabr.)										2	1(0,3)	2						
Porhydrus lineatus (Fabr.)													1	1(0,1)	1			
Coelambus impressopunctatus (Schall.)													1	1(0,5)	1			
Hygrotus ineaqualis (Fabr.)							37	18(2,4)	1-5 (2,1)									
Hygrotus versicolor (Schall.)							20	10(0,6)	1-5 (2,0)									
Scarodytes halensis (Fabr.)										7	2(0,9)	3-4 (3,5)	2	1(0,4)	2			
Bidessus pusillus (Fabr.)										2	2(0,7)	1						
Hyphydrus ovatus (L.)				1	1(0,2)	1	12	11(0,2)	1-2 (1,1)	8	8(1,4)	1	2	2(0,4)	1			
Laccophilus hyalinus (Degeer)										2	2(0,6)	1						
Laccophilus minutus (L.)										3	3(1,5)	1	1	1(0,5)	1			
Colymbetes striatus (L.)										2	2(0,4)	1						
Acilius canaliculatus (Nic.)										1	1(4,3)	1						
Ochthebius minimus (Fabr.)																5	5(0,7)	1
Helophorus aquaticus (L.)													2	1(0,9)	2			
Helophorus flavipes Fabr.	1	1 (1,1)	1										1	1(1,1)	1			
Helophorus granularis (L.)													1	1(0,3)	1			
Helophorus griseus Herbst																3	1(0,3)	3
Helophorus minutus Fabr.													3	3(1,5)	1			
Helophorus nanus Sturm													1	1(0,4)	1			
Coelostoma orbiculare (Fabr.)							3	1(2,1)	3									
Hydrobius fuscipes (L.)													3	3(0,9)	1			
Anacena limbata (Fabr.)										1	1(0,2)	1						
Anacena lutescens (Steph.)													4	4(0,5)	1			
Laccobius minutus (L.)							4	1(0,1)	4	2	2(0,1)	1	7	7(0,4)	1	1	1(0,06)	1
Laccobius sinuatus Motsch.													1	1(2,2)	1			
Helochares lividus (Forst.)													2	1(0,5)	2			
Helochares obscurus (O. F. Müll.)										1	1(0,9)	1	3	1(0,9)	3			
Enochrus melanocephalus (Oliv.)													1	1(2,0)	1			
Enochrus quadripunctatus (Herbst)													1	1(1,5)	1			
Enochrus testaceus (Fabr.)										1	1(2,1)	1	6	1(2,1)	6			
Enochrus affinis (Thunb.)													1	1(0,1)	1			
Enochrus coarctatus (Gredl.)													9	2(2,7)	2-7 (4,5)			
Cymbiodyta marginella (Fabr.)													3	3(1,0)	1			
Total	1	1 (0,004)	1	17	10 (0,04)	1-6 (1,7)	78	43 (0,16)	1-5 (1,8)	110	80 (0,3)	1-7 (1,4)	57	40 (0,15)	1-7 (1,4)	9	7 (0,03)	1-3 (1,3)

this stage before were recorded. One of them was preliminarily named as "*Eylais cf. relicta*" since its imagines were observed at the station where beetles infested with this species were caught. The other species is called here *"E. sp."*. The number of larvae of different water mite species varied from 158 (*E. longipalpis*) to one (*E. hamata*) (TABLE 1).

The water mite larvae of the genus *Eylais* were found on 76 species of beetles from five families: Haliplidae, Dytiscidae, Gyrinidae, Hydraenidae, and Hydrophilidae. The highest number (302) of water mite larvae from six species were found on Dytiscidae, followed by Hydrophilidae (175 larvae of 8 species), Gyrinidae (106 larvae of one species), Haliplidae (59 larvae of three species), and Hydraenidae (18 larvae of three water mite species) (TABLE 1).

Dytiscidae include the most important host species for *Eylais longipalpis, E. setosa,* and *E. koenikei*, and partially for *E. extendens* and *E. undulosa*. The main parasites of Hydrophilidae are *E. undulosa, E. muelleri,* and *E. sp.,* of Gyrinidae *E. cf. relicta* and of Haliplidae chiefly *E. extendens* and a small number of *E. longipalpis* and *E. muelleri* larvae. *Eylais tullgreni, E. bisinuosa,* and *E. glubokensis* are the only parasites of Hydraenidae.

The most frequently infected beetles were *Laccobius minutus* (109 larvae), *Gyrinus distinctus* (94), *Colymbetes fuscus* (51), *Hygrotus inaequalis* (43), *Haliplus immaculatus* (32), *Rhantus incognitus* (25), *Hyphydrus ovatus* (24), and *Hygrotus versicolor* (20). Of these host species, *Laccobius minutus* and *Hyphydrus ovatus* are infested by several species of parasites with dominance two of them (*Eylais muelleri, E. sp.* in *Laccobius minutus* and *Eylais setosa, E. extendens* in *Hyphydrus ovatus*). The remaining host species are infected by one numerically dominating parasitic species (TABLE 1).

Only 1.4 % of the whole collected beetles was infected by water mites larvae. The highest infection rate was found for *Gyrinus distinctus* (11.9%), *Ilybius subaeneus* (11.8%), *Cercyon bifenestratus* (10.0%), *Acilius canaliculatus* (8.7%), *Rhantus incognitus* (6.8%), *Hydroporus erythrocephalus* (6.4%), *Hygrotus versicolor* (6.2%), and *Haliplus lineolatus* (6.1%) (TABLE 1).

The average infection intensity varied from 1 to 4.1. per one beetle. The highest intensity of infection was found in *Eylais cf. relicta* with up to 21 larvae on one beetle (4.1 on the average) (TABLE 1).

No distinct correlation occurred neither between the numbers of host species and the number of infested individuals, nor between the numbers of host species and the number of larvae found on them, both with respect to the entire material and to most parasite species. Strong connections of this type characterize three species of water mites. Only for *E. muelleri* the respective correlation coefficients were 0.81 and 0.80, for *E. sp*. 0.92 and 0.95, and for *E. cf. relicta* —1 and —1. *Gyrinus marinus* an unquestionable accidental host for *Eylais cf. relicta* was not taken into consideration in the computation.

The most numerous species were: *E. longipalpis* (158 individuals), *E. extendens* (110), *E. cf. relicta* (106), *E. setosa* (78), *E. muelleri* (62), *E. undulosa* (57), and *E. sp.* (50 individuals) (TABLE 1).

The following order of the extensiveness of infection was determined: *E. relicta* (?) (2.5%), *E. bisinuosa* (2.2%), *E. sp*. (1.2%), *E. muelleri* (1.1%), *E. hamata* (1.1%), *E. setosa* (1.0%), *E. koenikei* (0.7%), *E. longipalpis* (0.7%), *E. glubokensis* (0.7%), *E. extendens* (0.6%), *E. undulosa* (0.5%), and *E. tullgreni* (0.3%).

Eylais hamata, E. bisinuosa, and *E. glubokensis* were collected from only one beetle species, the remaining parasites occurred on two or more host species. The highest number of hosts characterized *E. longipalpis* (28), *E. extendens* (26) and *E. undulosa* (23 host species) (TABLE 1).

Larvae were attached under the elytra to the central parts of abdomen between segments 1 and 4. Only single larvae were found lateral parts of these segments, more posteriorly or at the basis of the second pair of wings. *Eylais cf. relicta* was an exception, 70% of its larvae being found on the lateral parts of the first four segments of the abdomen (in the vicinity of the stigmata), 25% on the central parts of these segments, and 5% on the further segments of the abdomen.

The body size of the larvae varied from 0.13 mm to 7 mm. The strongest increase in size was found in *E. longipalpis, E. extendens,* and *E. undulosa.* In the case of *E. longipalpis* a eight larvae measured > 2 mm, in the remaining two species only one larva each exceeded 2 mm (*E. extendens* 4 mm and *E. undulosa* 7 mm). The larvae of *E. muelleri, E. setosa,* and *E. sp.* were

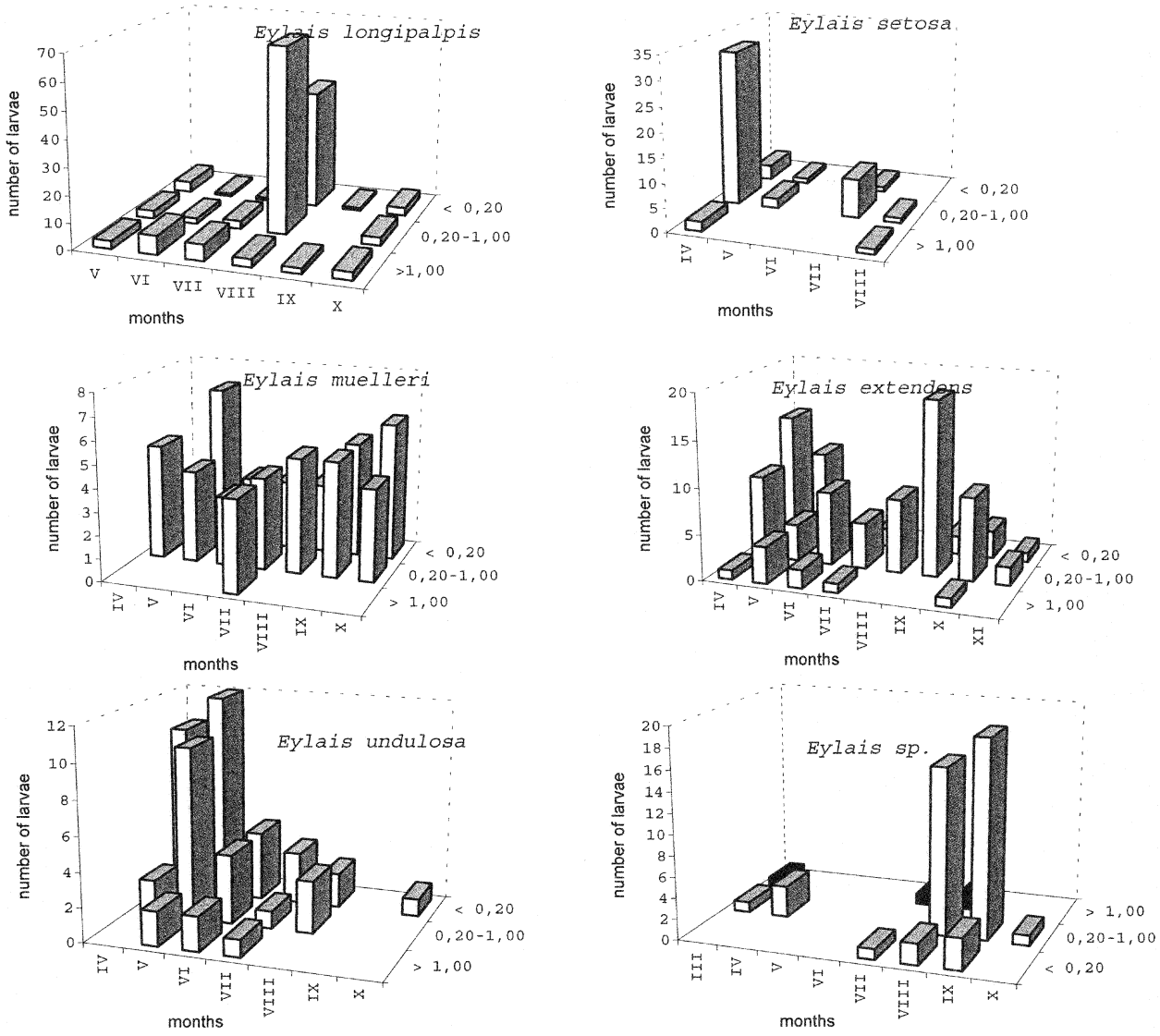

FIG. 1. — Relation between the number of larvae of different size and the date of sampling

0.25-2 mm in length, *E. koenikei* 0.25-1.5 mm, and *E. cf. relicta* 0.15-0.25 mm. In the remaining species due to the low individual number it was impossible to determine increases in the body size of larvae at the parasitic stage of development. The larvae of E. hamata were 0.77 mm in length, E. tullgreni 0.16-0.40 mm, E. bisinuosa 0.18-0.4 mm, and E. glubokensis 0.8-1.00 mm.

Differences in the numbers of the smallest and largest larvae can be regarded as the measure of mortality at the parasitic stage of larval development. The determined mortality rate was 30% for *E. setosa*, about 50% for *E. longipalpis,* about 70% for *E. extendens*, and about 80% for *E. muelleri* and *E. undulosa*.

The seasonal frequency of size classes is given in FIG. 1. Small and medium-sized larvae of *E. setosa* and *E. sp*. appear in spring and in late summer. In *E. setosa* these larvae are more numerous in spring, in *E. sp*. in late summer. The largest larvae of *E. setosa* were also encountered in the two periods, these of *E. sp.* in late summer only. The small and medium-sized

larvae of *E. longipalpis, E. muelleri, E. extendens,* and *E. undulosa* occur during the entire season from spring to autumn. In the case of *E. undulosa,* intensified occurrence of small larvae was observed in spring, of *E. muelleri* and *E. extendens* both in spring and autumn, and of *E. longipalpis* in summer. The largest larvae of *E. muelleri* appear only in July, of *E. undulosa* in May-July, of *E. extendens* twice (in spring-summer, and in October), and of *E. longipalpis* all the time from May to October, with more intensity of occurrence in June and July.

Environmental diversity of parasitism

The largest number of water mite larvae was found on beetles caught in the littoral of lakes (349), follow by small eutrophic water bodies (207), small forest water bodies (53), sphagnous peat bogs (37), running waters (10) and astatic water bodies (4).

For single habitat types, the order of abundance was as follows:

Littoral of lakes: *E. cf. relicta* (105), *E. extendens* (77), *E. setosa* (48), *E. muelleri* (44), *E. sp.* (41), *E. undulosa* (19), *E. longipalpis* (12), *E. tullgreni* (3 larvae).

Small eutrophic water bodies: *E. longipalpis* (111), *E. undulosa* (26), *E. setosa* (20). *E. muelleri* (14). *E. extendens* (12), *E. glubokensis* (7), *E. koenikei* (6), *E. bisinuosa* (6), *E. tullgreni* (4), *E. sp*. (1 larva).

Small mid-forest water bodies: *E. extendens* (17), *E. setosa* (8), *E. undulosa* (8), *E. sp*. (7), *E. longipalpis* (5), *E. muelleri* (4), *E. tullgreni* (2), *E. koenikei* and *E. cf. relicta* (1 larva each).

Peat bogs: *E. longipalpis* (29), *E. extendosa* (3), *E. setosa* and *E. undulosa* (2 larvae each), *E. keonikei* (1 larva).

Running waters: *E. koenikei* (9 larvae), *E. extendens* (1 larva).

Astatic water bodies: *E. undulosa* (2), *E. longipalpis* (1), *E. sp*. (1 larva).

Discussion

General characteristics of parasitism

Larvae of water mites of the genus *Eylais* were found as parasites on water beetles from five families. Thus the host range is distinctly wider than that of the genus *Hydrachna* which parasitized beetles from two families only (Zawal, 2002). As *Hydrachna*, beetles restricted to mountain regions, rapidly flowing waters, and acidic waters are not potential hosts of *Eylais*, because they do not occur in the above environments. Single records of mite larvae on acidophilous species (*E. extendens* on *Hydroporus angustatus*, *Eylais koenikei* on *Hydroporus umbrosus*, *Eylais longipalpis* on *Hydaticus seminiger*) suggest that the parasitism of *Eylais* on acidophilous beetles is generally limited by ecological rather than physiological factors.

Apart from *Graphoderus* sp. (Sparing 1959) and *Haliplus ruficollis* (Nielsen & Davids 1975), both infected by *Eylais setosa* all known beetle hosts of *Eylais setosa, E. extendens,* and *E. glubokensis* were confirmed in the present work. Former data concerning *E. extendens* as a parasite of Heteroptera i.e. *Hesperocorixa atopodonta* and *Belostoma flumineum* (Lanciani 1970) and also *Sigara falleni, S. striata,* and *S. distincta* (Sparing 1959), probably concern different species e.g. (Nielsen & Davids 1975). Most probably various species of the *Eylais* parasitize either Coleoptera or Heteroptera . This also concerns *Eylais extendens*, for which only water beetles are ascertained as hosts.

Differences in host range between the genera *Hydrachna* and *Eylais* are due to differences in the environmental distribution of these two water mites genera. Beetle hosts of the genus *Hydrachna* chiefly colonize astatic waters (Zawal, 2002) while the respective *Eylais* species cover a much wider spectrum of environments.

Most water mites of the genus Eylais parasitizing water beetles are regarded as species of small water bodies, or even as eurytopic. The pattern of host species described here suggests considerable differences in the habitat preference of their parasites as well (Table 1.). The beetle species which are preferred host of one species of parasites, are usually parasitized by other species to a lower degree.

Such species as *E. extendens, E. undulosa, E. setosa,* and *E. muelleri* are found in the littoral of lakes more frequently than other species of the genus. Therefore, a considerable number of beetles occurring in small water bodies, which rather frequently migrate to the

littoral of lakes, appear in the list of hosts together with lake species. In the case of *E. extendens* the latter species of the genus *Haliplus*, particularly *H. flavicollis* and *H. fluviatilis*. *Eylais undulosa* and *E. muelleri* are chiefly parasites of beetles of the family Hydrophilidae, which frequently colonize the shallowest zone of the lake littoral. Apart from species inhabiting small-water bodies (*Hygrotus inaequalis* and *Hyphydrus ovatus*) *Eylais setosa* intensively infects the lake species *Hygrotus versicolor*.

Due to unsettled taxonomic questions not much is known about the ecology of *Eylais longipalpis*. The list of hosts of this species (chiefly fairly large beetles of the family Dytiscidae) suggests a preference for small-water bodies.

Eylais koenikei is regarded as a springtime species typical for astatic waters (Biesiadka 1972). Its hosts are eurytopic species with a pronounced migration tendency: in the spring season they colonize astatic waters.

Eylais relicta is rare species with northern distribution (Lundblad 1968), in Poland only known from Lobelia-type lakes (Biesiadka & Cichocka 1997). Therefore it is not surprising that it parasitizes chiefly the lake-dwelling species *Gyrinus distinctus*.

The fairly infrequent water mite species *E. tullgreni, E. bisinuosa* and *E. glubokensis* in this study were found only parasiting beetles of the family Hydraenidae. They were found only in small water bodies, though their ecology is not clearly defined on account of the rare occurrence and doubtful taxonomy. All beetles found infested by them are typical species of small-water bodies, temporarily occurring in astatic waters (Galewski 1990).

It is not quite clear whether the differences in the selection of hosts result from their environmental distribution or, to the contrary, the differences in the environmental distribution result from differences in the selection of host species. Though, it is obvious that the environmental distribution of parasites is closely related to the habitat preference of beetles infested by them. Water mites which have more hosts (*E. longipalpis, E. extendens, E. undulosa)* have lower habitat preference.

As compared with the genus *Hydrachna,* infestation rate is extremely low. This observation is surprising as the natural population density of *Hydrachna* is much lower than in *Eylais.* This differences could be explained by the higher variety and abundance of the beetle species infected by the genus *Eylais*, and hence the increased scattering of parasites.

It is interesting that, except for *E. cf. relicta,* the highest infection rate was found in species represented by rather low abundance of larvae such as *E. bisunousa, E. sp., E. muelleri,* or *E. hamata*. These species infested much less beetles species than the abundantly occurring parasites. Both the small number of host species and the fairly high infection rate suggest a narrow host specifity of these parasites.

Vice versa, a high rate of parasitism is found also on the host species, which occurred in scarce numbers. Several reasons may be proposed as an explanation: in some cases this may be due to an accidental situation. If a host species occurring in small numbers is infected (by a very small number of water mite larvae) the resulting infestation rate may become very high. This is probably the case with *Haliplus lineolatus, Ilybius subaeneus, Acilius canaliculatus,* and *Cercyon bifenestratus*. Another possible reason is the habitat preference of the parasite. This concerns *Eylais cf. relicta* which occurs in lakes of low trophic level. Therefore its chief host is the typically lake species *Gyrinus distinctus*, which is much more numerous in this environment than the two remaining *Gyrinus* species. The third possible reason is the changing structure of dominance of the coleopterofauna. As the most infected species possibly were more numerous in the past, when the host-parasite relation was formed they could have belonged to the most easily accessible prey. This concerns *Hydroporus erythrocephalus* and *Hygrotus versicolor* and, maybe, some species of beetles mentioned above as less numerous. The last observation can also concern lake species such as *Hygrotus versicolor* and *Gyrinus distinctus* which can become less and less important owing to the increasing eutrophication of waters.

The lack correlation coefficient determined between the numbers of the different host species and the number of infested individuals on the one hand, and the correlation coefficient between the number of the different species of beetles and the number of

larvae collected on them on the other, for the entire material and for the different water mite species suggests a pronounced dispersion of parasites among the host species. However it shows certain preferences, which force the parasite to select not necessarily the most frequent beetle host. Exception are made by *Eylais muelleri, E. cf. relicta* and *E. sp*. E. muelleri and *E. sp*. are characterized by a high positive correlation owing to the narrow specialization to one host species (*Laccobius minutus*) from the group of the most numerous species of beetles, all other species are sporadically infected. The exceedingly high negative correlation found for *Eylais cf. relicta* is due to its preference for the much less numerous *Gyrinus distinctus.*

The low intensities of infestation could be interpreted as an adaptation trait. With increasing dispersion, the probability of reproduction success increases as well. Additionally, a considerable increase in body size at the stage of the parasitic larva, requires a large space on the body of the host, and thus a low parasite density in the subelythral space.

The location of parasites under the elytra prevents larvae from mechanical damage during the movement of beetles. Hence in this stage the mortality is lower compared with parasites attached on the outer surface (Cichocka 1995, Zawal in press). In the case of *E. muelleri, E. extendens,* and *E. undulosa* the wintering of their Haliplid and Hydrophilid hosts outside the water bodies could explain the high mortality at the larval stage.

Analysis concerning the dependence of the body size of larvae on the date of sampling allows for determining the time of the parasite invasion of the hosts and the time of transformation of larvae into deutonymphs. From the occurrence of the smallest larvae during the entire vegetation season results a considerably prolonged reproduction period, in all the most numerous species recorded here (Fig.1). In the case of *Eylais setosa* and *E. sp*., the lack of records of the smallest larvae at several dates is probably result of the small number of larvae. The peaks of abundance in some months shows the intensification of the reproduction process at that time. Also the occurrence of more than one generation per year is possible. *E. setosa, E. muelleri. E. extendens,* and *E. sp.* might have produced two generations, in spring and in summer. *E. undulosa* might be an one-generation species, but reproducting through the entire spring and summer period. In the case of *E. longipalpis,* the occurrence of three generations, in spring, summer, and autumn, is possible, but fairly improbable, since the development time of one generation would be rather short.

Environmental conditions of parasitism

Both the imagines of most species of the genus *Eylais,* and their typical beetle hosts, are associated with small eutrophic water bodies and the littoral of lakes. Though, since beetles associated with these environments are highly mobile, infected beetles were also found in other environments. The greatest numbers of larvae were found on beetles caught in the littoral of lakes and belong to *E. cf. relicta, E. extendens, E. setosa, E. muelleri,* and *E. sp.* These species so far were regarded as typical for small-water bodies, but found in the littoral of lakes in higher numbers than the remaining species of the genus *Eylais.* Their abundance in this environment, as well as the fact that the beetles infested are associated with the littoral of lakes than with small eutrophic water bodies, suggest that littoral of lakes is the preferred habitat type at least for *E. extendens, E. setosa,* and *E. muelleri*, while small eutrophic water bodies play the role of an additional, refugial environment.

The highest numbers of *E. longipalpis* and *E. glubokensis* larvae *we*re found on beetles caught in small eutrophic water bodies. This abundant occurrence on beetles typically associated with this environment suggests that small-water bodies are the preferred habitat character of these water mites species.

The condition of *E. koenikei,* spring time species typical for astatic waters is interesting. Since the coleopterofauna typical for this environment is not available (in spring), *E. koenikei* imagines infect (small-water bodies) beetles, which in spring temporarily occur in astatic waters. After the latter are dried, the beetles migrate to other water bodies. Hence, the *E. koenikei* larvae are found on beetles caught in different environments.

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