Studies on helminth parasites of the small field mouse (Apodemus microps) and the common vole (Microtus arvalis) from a pine forest in Hungary

András GUBÁNYI¹, Ferenc MÉSZÁROS¹, Éva MURAI¹ and Attila SOLTÉSZ²*

¹ Zoological Department, Hungarian Natural History Museum, Baross u. 13, H-1088 Budapest, Hungary
² University of Veterinary Science, H-1400, P.O. Box 2, Budapest, Hungary
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Abstract: The helminth fauna of the small field mouse (Apodemus microps Kratochvil and Rosicky, 1952) and the common vole (Microtus arvalis Pallas, 1778) was studied in a pine forest at Babat (County Pest). A total of 9 parasitic helminths were recovered from the small field mouse, which is reported for the first time as a new host of Anoplocephaloides dentata, Hymenolepis fraterna, Hymenolepis diminuta and Hymenolepis muris-sylvatici. Only well-known helminths were found in common voles, but Heligmosomum costellatum was lacking. The prevalence of parasitic helminths in the two micromammalian species remained beyond what would have been expected. A remarkable seasonal difference was observed in parasite composition by sex of the host species.

Keywords: Apodemus microps, Microtus arvalis, parasitic helminths, seasonal variation, weight category, pine forest, Hungary

INTRODUCTION

Numerous studies, mostly faunistical and taxonomical investigations, have been published on the parasitic helminths of the common vole (Microtus arvalis Pallas, 1778) in the Carpathian basin (Murai and Tenora 1973, Tenora et al. 1973, Murai 1974, Mészáros 1977, Mészáros and Murai 1979, Tenora et al. 1985). In contrast with the

* graduating student of veterinary medicine
common vole, the helminth fauna of the small field mouse (*Apodemus microps* Kratochvil and Roščiký, 1952) has not been reviewed, and only limited data are available. Murai (1982) emphasized the low infection rate of *A. microps* with larval taeniids. *Heligmosomoides polygyrus* was recovered by Mézáros et al. (1981) and Matskási et al. (1990) from different localities in Hungary. Mézáros et al. (1981) also detected *Syphacia frederici*. Tënora and Mézáros (1975) reported on the occurrence of *Syphacia stroma* (Linstow, 1884) in Slovakia. On the other hand, a number of helminthological studies have also investigated the tapeworms parasitic in other apodemid species in Hungary (Murai 1972, Murai and Tenora 1972, Tenora and Murai 1972, Tenora and Murai 1980, Tenora et al. 1980).

Host-parasite interactions of the above-mentioned micromammals, however, have not been considered in great detail. Mézáros (1980) discussed the seasonal patterns in the population dynamics of both the common vole and its parasites. Quantitative and qualitative analyses of helminths and their indicator characteristics have been studied, too (Kisielewska 1971, Ténora et al. 1973). At the same time, no information is available about the seasonal pattern of parasites of the small field mouse and about the host-parasite interaction. Interest has been focused only upon broad patterns of interaction between the wood mouse (*Apodemus sylvaticus* L.) and a range of helminth species in Britain and Ireland (see Elton et al. 1931, Lewis 1968, Lewis and Twigg 1972, Gregory 1992 for review).

The quantitative and qualitative patterns of helminths parasitizing a small field mouse and a common vole population are reported in this paper.

**MATERIAL AND METHODS**

Samples of *A. microps* and *M. arvalis* were collected by A. Demeter using box traps at Babat (Pest county) in an artificially planted pine forest between April 1978 and April 1990. In the framework of sylvicultural activity the forest was treated annually with chemical weed-killers.

As shown in the Table 1, the animals were captured mostly in the autumn and in the spring. For each individual, sex, body weight, data of capture and morphological measurements were recorded in the field. Subsequently, the animals were stored at -18 °C until used for parasitological investigation. The helminths were fixed in 5% of hot formalin with saline and preserved in 4% of formalin. Whole mount preparations were stained with iron-carmine, alum-carmine and Ehrlich’s haematoxylin for cestodes. Rostellar hooks and eggs were prepared in Berlese solution. Nematodes were translutened in lactophenol solution. Trematodes were not found in the host species. Taking into consideration that the family Hymenolepididae has not been reviewed, the species belonging to it are discussed as s. l. gen. Hymenolepis. General prevalence and intensity, prevalence and mean intensity of parasitic infection were calculated for weight categories in both sexes of the host species. Studies on the host-parasite interactions will be reported elsewhere (Demeter et al. 1993, in preparation).
Helminth parasites of A. microps and M. arvalis

Table 1
Number of samples and weight categories for *Apodemus microps* and *Microtus arvalis*

<table>
<thead>
<tr>
<th>Weight Categories (g)</th>
<th>Apodemus microps</th>
<th>Microtus arvalis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>≥ 11</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>12-14</td>
<td>50</td>
<td>44</td>
</tr>
<tr>
<td>15-17</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td>18-20</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>21 ≤</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Spring</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Summer</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Autumn</td>
<td>77</td>
<td>77</td>
</tr>
<tr>
<td>Winter</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

M = number of males, F = number of females

RESULTS

CESTODA

ANOPLOCEPHALIDAE Cholodkowsky, 1919

*Anoplocephaloides dentata* (Galli-Valerio, 1905)

Syn.: *Paranoplocephala brevis* (Kirschchenblat, 1938)


*Paranoplocephala omphalodes* (Hermann, 1783) Lühe, 1910

Syn.: *Aprostatandrya macrocephala* (Douthitt, 1915)


*Paranoplocephala janickii* Tenora, Murai et Vaucher, 1985


HYMENOLEPIDIDAE Railliet et Henry, 1909

*Hymenolepis asymmetrica* Janicki, 1904

= *Vamiprolepis asymmetrica* (Janicki, 1904)


*Hymenolepis diminuta* (Rudolphi, 1819)

Hymenolepis fraterna (Stiles, 1906)  
= Hymenolepis nana (Siebold, 1852)
Host: Apodemus microps. - Intermediate hosts: beetles (Coleoptera) or without intermediate host. - Localization: small intestine

Hymenolepis horrida (Linstow, 1901)

Hymenolepis muris-sylvatici (Rudolphi, 1819)  
= Passerilepis crenata (Goeze, 1787)

TAENIIDAE Ludwig, 1803

Cladotaenia globifera (Batsch, 1786) Cohn, 1901 -metacestodes-

Taenia taeniaeformis (Batsch, 1786) -metacestodes-
Syn.: Hydatigera taeniaeformis (Batsch, 1786) Lamarck, 1816

Taenia mustelae (Gmelin, 1790) -metacestodes-
Syn.: Taenia tenuicollis (Rudolphi, 1819)
Name of larva: Cysticercus talpae Rudolphi, 1819. - Host: Mustela nivalis, Martes foina. - Intermediate host: Microtus arvalis. - Localization in the intermediate host: liver tissue.

NEMATODA

TRICHOCEPHALIDAE Baird, 1853 (Trichuridae Railliet, 1915)

Trichocephalus muris Schrank, 1788
Syn.: Trichurus muris (Schrank, 1788)
Host: Microtus arvalis. - Localization: caecum, rectum.
Apodemus microps

Seasonal variations

The number of individuals collected in summer and winter is insufficient for a detailed comparison of the dynamics of the helminth fauna. The general prevalence (GP) for male *Apodemus microps* was 66.6% in the spring. At the same time the GP for females was lower (54.5%). In contrast with the results obtained in the spring, the GP, obtained for males and females decreased considerably in the autumn (19.4 and 15.6%, respectively). From the general intensity obtained for the small field mouse it can be concluded that animals showed an infection of slightly higher intensity in the spring (14.2 h/male, 15.2 h/female) than in the autumn (12.5 h/male, 9.3 h/female). Of the 8 helminth species found in *A. microps* in the spring, the invasion of *H. polygyrus* reached the highest degree. On the other hand, in the autumn the prevalence of *C. globifera* larvae proved to be the highest (Table 2). Only four helminth species, *C. globifera* and *T. taeniaeformis* larvae, *H. polygyrus* and *S. stroma*, were demonstrated in individuals captured in the summer and winter season.
Taking into account all specimens of *A. microps* examined, 73.7, 18.5, 3 and 9% of all males was infected by one, two, three, and four parasites, respectively. Females were infected only by one or two species (83.3 and 16.7%, respectively).

Table 2

|                  | Spring | | Summer | | Autumn | | Winter |
|------------------|--------||--------||--------||--------||--------|
|                  | male   | | female | | male   | | female | | male   | | female |
| H. diminuta      | (15/10)| | (11/6)  | | (6/0)  | | (4/2)  | | (77/15) | | (77/12) | | (6/2)  | | (5/1)  |
| H. fraterna      | 14.3   | | 0       | | 0       | | 1.2     | | 0       | | 0       | | 0       | | 0       |
| H. muris-sylvatici | 13.3   | | 0       | | 0       | | 1.2     | | 1.2     | | 0       | | 0       | | 0       |
| C. globifera     | 14.3   | | 9.1     | | 25      | | 2.5     | | 2.5     | | 16.6    | | 20.0    | | 0       |
| T. taeniaeformis | 14.3   | | 27.3    | | 25      | | 6.5     | | 9.1     | | 0       | | 20.0    | | 2.0     |
| H. polygyrus     | 46.6   | | 36.4    | | 0       | | 5.2     | | 1.2     | | 16.6    | | 0       | | 0       |
| S. frederici     | 13.3   | | 0       | | 0       | | 2.5     | | 1.2     | | 0       | | 0       | | 0       |
| S. stroma        | 0      | | 9.1     | | 25      | | 3.8     | | 2.5     | | 0       | | 0       | | 0       |

* ratio of examined and infected specimens,
** prevalence,
*** intensity

Fig. 1. General prevalence and intensity of parasitic helminths in *A. microps* by weight category.
Growth and helminth infection

The pattern of infection for male and female mice within a given weight classes was similar, except for the large animals (≥ 21 g). Maximum prevalence was observed in mice weighing 18-20 g. The highest general intensity was found in young (11 ≤ g) animals and decreased with the progress of host weight in both males and females. A second peak was also identified in adult female (18-20 g) individuals (Fig. 1).

Peaks and profiles of the general prevalence and intensity for male and female mice were derived from different species composition (Fig. 2, Fig. 3). Dominant species of 15-17 g males were *H. polygyrus*, *S. Frederici*, *H. diminuta*, *H. fraterna* and *C. globifera* and *T. taeniaeformis* larvae. *H. polygyrus*, *H. fraterna* and *C. globifera* larva showed a higher mean intensity value in this weight category. *H. polygyrus*, *S. Frederici*, *H. fraterna* and *T. taeniaeformis* larva exhibited an increase of infection parallel to host weight and showed a high prevalence in 18-20 g male mice. Of the four above-mentioned helminths, only *T. taeniaeformis* showed a high mean intensity. At the maximum value of general intensity, the dominant species was *S. stroma* (Fig. 2). *A. dentata* manifested in only one 14 g male individual.
Contrary to the above, the general intensity obtained for younger female mice depended only on the burden of *C. globifera* larva, observed in two *A. microps* (weight category: ≥ 11 and 12-14 g, respectively). The prevalence of *H. polygyrus*, *S. stroma*,

![Graphs showing prevalence and intensity of parasitic helminth species.](image)

**Fig. 3.** Prevalence and mean intensity of parasitic helminth species in female *A. microps* by weight category

<table>
<thead>
<tr>
<th>Season</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>80.0**</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Summer</td>
<td>0</td>
<td>50.0 (1)</td>
<td>22.2 (2)</td>
<td>16.6 (2)</td>
</tr>
<tr>
<td>Autumn</td>
<td>0</td>
<td>0</td>
<td>7.8 (1.5)</td>
<td>11.0 (1.5)</td>
</tr>
<tr>
<td>Winter</td>
<td>0</td>
<td>0</td>
<td>5.9 (1.0)</td>
<td>1.0 (2.0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
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<tbody>
<tr>
<td>D. dentata</td>
<td>80.0**</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>P. omphalodes</td>
<td>0</td>
<td>50.0 (1)</td>
<td>22.2 (2)</td>
<td>16.6 (2)</td>
</tr>
<tr>
<td>P. janickii</td>
<td>0</td>
<td>11.1 (2)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>H. asymmetrica</td>
<td>0</td>
<td>0</td>
<td>3.9 (13.5)</td>
<td>1.0 (2.0)</td>
</tr>
<tr>
<td>H. horrida</td>
<td>0</td>
<td>1.9 (1.0)</td>
<td>1.0 (2.0)</td>
<td>12.5 (2.0)</td>
</tr>
<tr>
<td>T. taeniaeformis</td>
<td>0</td>
<td>0</td>
<td>5.9 (1.0)</td>
<td>2.0 (1.0)</td>
</tr>
<tr>
<td>T. mustelae</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0 (3.0)</td>
</tr>
<tr>
<td>T. muris</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0 (2.0)</td>
</tr>
<tr>
<td>H. laevis</td>
<td>20.0 (6)</td>
<td>50.0 (1)</td>
<td>0</td>
<td>1.9 (1.0)</td>
</tr>
<tr>
<td>S. nigeriana</td>
<td>0</td>
<td>11.1 (2)</td>
<td>0</td>
<td>8.0 (9.5)</td>
</tr>
</tbody>
</table>

* * * ratio of examined and infected specimens
** ** prevalence
*** *** intensity
and *T. taeniaeformis* larva increased gradually by weight category in females. It was mostly these three species which contributed to the value of the general prevalence. The explosion-like intensity of *H. polygyrus* infection was similar to that seen in males. In contrast with male mice, from females *H. diminuta* and *H. muris-sylvatici* were not recovered. Burdens of *S. frederici* and *H. fraterna* were not substantial in females either (Fig. 3).

**Microtus arvalis**

*Seasonal variations*

As shown in the Table 3, the animals were collected mainly in the autumn; thus, no quantitative comparison was possible. However, it is worth noting that *A. dentata*, *P. omphalodes* and *H. laevis* showed a high prevalence in spring and winter in spite of the small number of samples. In the present study, 7 cestode and 3 nematode species were recovered in autumn. Only three helminths, *A. dentata*, *P. omphalodes* and *P. janickii* were important from the point of view of the infection (see Table 3). Infection by *H. laevis* appeared a decrease (1.9% for males and 6.0% for females) in autumn, as compared to winter and spring samples. Males were parasitized by 1 or 2 specimens of helminths (75.0 and 25.0%, respectively) and females by 1-3 (66.6, 22.2 and 11.2%, respectively).
Growth and helminth infection

Considering the weight categories the worm burdens showed a similar profile for male and female voles. General prevalence of infection in both sexes increased and attained its maximum in voles weighing 20-24 g (63.3% and 50.0%, respectively), but decreased thereafter. As shown in Fig. 4, the general prevalence was higher for males than for females. Different profiles of general prevalence and intensity were found in the two sexes, but the trend of prevalence showed characteristics similar to the intensity seen in females (Fig. 4). In contradiction to females where the maximum of general intensity occurred in 20-24 g animals, in males the general intensity fluctuated and reached the maximum in older specimens (30 ≤ g). *H. laevis, T. taeniaeformis* larva, *P. janickii, A. dentata* and *T. mustelae* were responsible for the maximum of the general

![Fig. 5. Prevalence and mean intensity of parasitic helminth species in male *M. arvalis* by weight category](image-url)
prevalence, seen in 20-24 g males. Of these helminths, *H. laevis* and *P. janickii* also manifested comparatively high prevalence in younger (≥ 14 g) and older (≤ 30 g) voles (Fig. 5). Only one species, *P. janickii*, seemed to be positive in all the weight categories.

![Graphs showing prevalence and mean intensity of parasitic helminth species in female *M. arvalis* by weight category](image_url)

**Fig. 6.** Prevalence and mean intensity of parasitic helminth species in female *M. arvalis* by weight category

*H. horrida*, *P. omphalodes* and *T. mustelae* proved to be the typical cestodes of 15-19 g males, but their prevalences remained at a low level. It is worth mentioning
that the prevalence and mean intensity peaks of *H. laevis*, *S. nigeriana*, *P. omphalodes* and *A. dentata* did not add up. Generally, *T. taeniaeformis* larva and *P. janickii* also caused a low infection. Comparing the prevalence and intensity profiles by sex, a difference was observed in the composition of the recovered helminths (Fig. 5, Fig. 6). Infection by *T. muris* was seen in one female specimens only. The prevalence of *H. laevis* reached the maximum in older (30 ≤ g) females. *P. omphalodes* and *P. janickii* also showed the highest prevalence in this category. Infection by *T. muris*, *H. horrida*, *H. asymmetrica* and *T. mustelae* was found in one weight category each. *S. nigeriana* and *T. taeniaeformis* larva were recovered from different weight classes, but they were absent from older animals. The prevalence of *T. taeniaeformis* larva also exceeded 10%. Primarily *H. laevis* was responsible for the maximum of general intensity, attained in 20-24 g females. *P. omphalodes* showed the highest value of mean intensity in 20-24 g females. Of the other species recovered, only *S. nigeriana* was noteworthy. On the other hand, an opposite trend in the prevalence and mean intensity of *H. laevis* was demonstrated as a function of female host weight (Fig. 6).

**DISCUSSION**

In the literature this is the first report of *A. microps* as a new host species for *Anoplocephaloides dentata*, *Hymenolepis fraterna*, *Hymenolepis diminuta* and *Hymenolepis muris-sylvatici* (cf. Tenora and Mészáros 1975, Murai 1982, Matskási et al. 1990). The prevalence of *A. dentata* was generally very low (1%) in *A. microps*. However, it is a well-known cestode of microtid species (Murai 1974, Tenora and Murai 1980). Before this study, *H. fraterna* had not been recovered from the small field mouse living in the Carpathian basin (cf. Murai 1972, Tenora and Murai 1980, Tenora et al. 1980). This and the other hymenolepid cestode, *H. diminuta* showed a low prevalence (2.05, and 1.02 %, respectively), similar to that obtained for *A. sylvaticus* and *A. agrarius* (cf. Murai 1972, Tenora and Murai 1972, see Table 4). The above authors emphasized that *H. muris-sylvatici* is identical with *H. crenata* parasitizing birds (Passeriformes). The maximum and profile of general prevalence and intensity were observed in the same weight category. According to our investigation, adult mice seemed to have a higher infection rate than did younger ones. On the other hand a higher intensity of infection was found in juvenile animals.

Numerous contradictory data exist on susceptibility varying by sex (see Gregory 1992 for a review). The present study has confirmed the results of previous field studies, i.e. that male host are more susceptible than females (cf. Lewis 1968, Lewis and Twigg 1972). These findings may be associated with the different growth profile, feeding habits, reproductive condition and neuroendocrine background of the two sexes.

Different characteristics were recognized in the profile of helminth infections. *H. polygyrus* appeared with an explosion-like invasion in older females (18-20 g), with concurrent peaks of prevalence and mean intensity. This feature was observed also in
males, but for 15-17 g animals only, which may be related to sylvicultural factors, although the effect of the chemical weed-killers applied on the development of helminth eggs and thus, invasion by geohelminths has not been investigated.

Massive infection of varying prevalence and mean intensity was observed for *T. taeniaeformis* larva, *H. fraterna* (only in males) and *S. stroma* (only in females). The low level of prevalence of *Syphacia* spp. in young female mice might be due to the earlier leaving of the nest. The helminth fauna of *Microtus arvalis* produced the expected and usual characteristics, except for *Heligmosoides costellatum*, which was absent. In view of the data published about the prevalence of helminth infections, the following facts can be established. The prevalences of *H. horrida* and *H. asymmetrica* (1.5%) corresponded to that found in other investigations. The prevalence of *T. taeniaeformis* larva and *T. mustelae* (0.5%) was below the value reported in the literature. Infection by *H. laevis* (8%), *S. nigeriana* (8%) and *T. muris* (0.5%) also proved to be low (cf. Table 4). In spite of the average prevalence of *A. dentata* (7.5%), *P. omphalodes* (10%) and *P. janickii* (9%), general prevalence in *M. arvalis* remained at a medium level (cf. Tenora et al. 1973, Murai 1974, Mészáros 1980).

Studying the dominant species (see Tenora et al. 1973) by the weight category the burden of *H. laevis* gradually increased, in agreement with data of Kisielewska (1971) and Mészáros (1980), obtained from different localities. The profile of *S. nigeriana* earlier leaving of the nest. The helminth fauna of *Microtus arvalis* produced the expected and usual characteristics, except for *Heligmosoides costellatum*, which was absent. In view of the data published about the prevalence of helminth infections, the following facts can be established. The prevalences of *H. horrida* and *H. asymmetrica* (1.5%) corresponded to that found in other investigations. The prevalence of *T. taeniaeformis* larva and *T. mustelae* (0.5%) was below the value reported in the literature. Infection by *H. laevis* (8%), *S. nigeriana* (8%) and *T. muris* (0.5%) also proved to be low (cf. Table 4). In spite of the average prevalence of *A. dentata* (7.5%), *P. omphalodes* (10%) and *P. janickii* (9%), general prevalence in *M. arvalis* remained at a medium level (cf. Tenora et al. 1973, Murai 1974, Mészáros 1980).

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Studying the dominant species (see Tenora et al. 1973) by the weight category the burden of *H. laevis* gradually increased, in agreement with data of Kisielewska (1971) and Mészáros (1980), obtained from different localities. The profile of *S. nigeriana*
varied with increasing host weight and showed peaks in voles of higher body weight. On the other hand, \textit{P. janickii} occurred in all of the weight classes; thus, it seemed to be the dominant species in the common vole population examined at Babat.

In conclusion, the data presented here suggest that infection of the two micro-mammalian species by parasitic helminths remained beyond the expected level. A remarkable seasonal difference was observed in parasite composition by sex of the host species.

Gubányi A., Mészáros F., Murai É. and Soltész A.: A kislábú erdeiegér és a mezei pocok féregélősködőinek vizsgálata egy magyarországi erdei fenyvesben

A szerzők Babat (Pest-megye) térségében egy mesterségesen telepített erdei fenyvesen egy kislábú erdeiegérnek (\textit{Apodemus microps} Kratochvil et Rošicky, 1952) és a mezei pocoknak (\textit{Microtus arvalis} Pallas, 1778) a belső élősködő férgeit (Cestoda, Nematoda) vizsgálták. A kislábú erdeiegerekből azonosított 9 féregfaj közül 4, \textit{Anoplocephaloides dentata}, a \textit{Hymenolepis fraterna}, a \textit{Hymenolepis diminuta} és a \textit{Hymenolepis muris-sylvatici} a gazdaálatra nézve új volt. A \textit{Heligmosomum costellatum} kivételével - amely egyáltalán nem fordult elő - a mezei pockokból az irodalom által említett élősködőket mutatták ki. Az élősködő férgek fertőzőképességének prevalencia és intenzitás értékei a gazdaállatoknál vizsgált súlycsoportok esetében évszakok és alacsonyabb alacsonynak bizonyultak. Az ivarok tekintetében viszont lényeges eltérések mutatkoztak az egyes parasiták fertőzésének prevalenciájában és intenzitásában.

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**REFERENCES**


