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Contributions to knowledge on the helminths parasitizing several Arvicolidae (Rodentia) in Auvergne (France)

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Summary

In the localities of Espinat and Allanche (Auvergne district), 37 *Microtus arvalis*, 1 *Clethrionomys glareolus* and 22 *Arvicola terrestris* were dissected. In these hosts, 10 parasitic worms species were found. The following adults parasitized *M. arvalis: Anoplocephaloides dentata, Paranoplocephala* sp. (Cestoda) and *Trichuris muris* (Nematoda). As larval stages, there were species: *Echinococcus multilocularis, Taenia crassiceps, T. polyacantha, T. taeniaeformis, T. mustelae* and *Cladotaenia globifera*. In *A. terrestris*, the cestodes *E. multilocularis* (larva) and *P. dentata* (adult) were found. *Cl. glareolus* was parasitized by the larval cestodes *Cl. globifera* and by adult cestodes of *Catenotaenia* sp. Investigations have confirmed the circulation of *E. multilocularis* in the area study and corrected some previous knowledge on helminths rodent species in above localities.

Key words: Cestoda; Nematoda; Arvicolidae; France

Introduction

During investigations on the nature of *E. multilocularis* in the Auvergne district, the attention was concentrated also to the other helminthic species parasitic in Arvicolidae living there. The present study deals with the findings.

Material and Methods

The material was collected by the international expedition (Petavy, Deblock - France; Vaucher - Switzerland; Tenora - Czech Republic) in the localities Espinat and Allanche, Auvergne district, France during April 1995. Thirty seven (24 positive) *M. arvalis*, twenty two (5 positive) *A. terrestris* and one (1 positive) *Cl. glareolus* were examined using helminthological dissections. In the material of parasitic worms, 10 species were determined. For the determination, the adult cestodes (3 species) were stained with borax-carmine and mounted in Canada balsam, the cestode larvae (6 species) and the nematodes (1 species) were cleared using 1/3 glycerine-alcohol mixture. The morphology of cestode hooks was studied mostly from a lateral situation. The determination of cestode genera was performed according to Khalil *et al.* (1994).

Results

A) *Helminths parasitizing as adults*

Anoplocephaloides dentata (Galli Valerio, 1905)
Locality: Allanche
Hosts: *M. arvalis, A. terrestris*
Site: caecum, duodenum
Prevalence: *M. arvalis* - 35 %, *A. terrestris* - 18 %
Infection intensity: 1—3 specimens.

Notes: The species of which the synonym is *Paranoplocephala brevis* Kirschenblat, 1938 parasitizes, first of all, rodents of the family Arvicolidae, sporadically then members of the genus *Apodemus* (cf. Kirschenblat, 1938; Spassky, 1951; Erhardová and Ryšavý, 1955; Żarnowski, 1955; Wahl, 1967; Rausch, 1976; Tenora and Murai, 1980; Haukisalmi, 1986; Genov and Georgiev, 1988; Feliu *et al.*, 1991 and others). The specimens found by us correspond to the description by Wahl, 1967.

Paranoplocephala sp.
Locality: Espinat
Host: *M. arvalis*
Site: small intestine
Prevalence: 2.7 %
Infection intensity: 2 specimens.

Notes: Both specimens found were without gravid segments and without a part of mature segments. With its features, they belong to the genus *Paranoplocephala* Lühe, 1910 (cf. Rausch, 1976; Tenora *et al.*, 1986; Schmidt, 1986; Beveridge, 1994). Because we were not successful in making the first-rate preparations, species determination was not possible.

Catenotaenia sp.
Locality: Allanche
Host: *Cl. glareolus*
Site: small intestine
Prevalence and infection intensity: 1 cestode was found in the single *Cl. glareolus* captured.

Notes: The specimen found corresponds to the characteristics of the genus *Catenotaenia* Janicki. 1904 (cf. Tenora *et al.*, 1992; Quentin, 1994). We were not successful in making the first-rate preparation for the species determination. By its external morphology (segments are craspedont and trapezoid), it resemble the species *Catenotaenia henttoneni* Haukisalmi et Tenora, 1993.

Trichuris muris Schrank, 1788
Locality: Allanche
Host: *M. arvalis*
Site: caecum
Prevalence: 8 %
Infection intensity: 1—3 specimens.

Note: The species known in Europe with a high prevalence in *M. arvalis* (cf. Tenora *et al.*, 1973).

B) *Cestodes parasitizing as larval stages*

Echinococcus multilocularis Leuckart, 1863
Locality: Allanche
Hosts: *A. terrestris, M. arvalis*
Site: liver
Prevalence: *A. terrestris* - 4.5 %; *M. arvalis* - 2.7 %
Infection intensity: 1 cyst in each host.

Note: The cysts are without hooks; the findings confirmed the previous data of Deblock and Petavy, 1983; Petavy *et al.*, 1984 (Fig. 6).

Taenia polyacantha Leuckart, 1856 (Fig. 1.)
Locality: Allanche
Host: *M. arvalis*
Site: peritoneal cavity
Prevalence: 2.7 %
Infection intensity: 12 cysts in 1 host.

Notes: We found larval stages of elongated shape, 3—4 mm size, lying freely in the body cavity (cf. Wiger *et al.*, 1974). Deblock and Petavy (1993) write that the species *T. polyacantha* is noted for 21—30 x 2 hooks on the scolex: larger hooks measure 0.178—0.205 mm and smaller ones are 0.125—0.150 mm. In our material, the number of hooks on the scolex ranges from 29 to 32 x 2 which is in coincidence with the date presented by Joyeux and Baer (1936) from France and Abuladze (1964) from the former USSR. As the smaller number of hooks (e.g. 44—50), the specimens with this feature were found only in the USA (cf. Verster, 1969). In our material the hook lengths ranged from 0.179 to 0.189 mm and from 0.123 to 0.129 mm respectively, i. e. in the range which is reported by Deblock and Petavy (1993), but it differs from the values presented by Verster (1969).

As to the hooks morphology, our material coincides with their illustrations presented generally (cf. Vester, 1969; Murai, 1982; Loos-Frank and Zeyle, 1982; Deblock and Petavy, 1983). Large hooks always have conspicuously longer handles and shorter blades.

Taenia crassiceps (Zeder, 1800) (Fig. 2)
Locality: Allanche
Host: *M. arvalis*
Site: pleural and peritoneal cavities, lungs
Prevalence: 8 %
Infection intensity: over 100 specimens found in the body cavities, numerous specimens in the lungs.

Notes: Cysticerci found of spheric shape, 1—3 mm in size. Scolex with 16—18 x 2 hooks. Large hooks measure 0.177—0.180 mm, small ones are 0.120—0.123 mm. In one case, we found large hooks not fully developed (0.162—0.165 mm), which resulted morphologically in their shorter handles. The total hook length found by us corresponds to the variability reported by Abuladze (1964) and Verster (1969).

The metrical and sometimes also morphological variability of hooks leads often to confusing the species *T. crassiceps* and *T. ovis* (Cobbold, 1896) (compare the illustrations by Neveu-Lemaire, 1936; Abuladze, 1964; Verster, 1969; Tenora and Kullmann, 1970a; Petavy and Deblock, 1980; Deblock and Petavy, 1993). Prokopič (1965) warns on the possibility to confusing the species *T. crassiceps* and *T. hydatigena* Pallas, 1766.

Well-developed large and small hooks of the species *T. crassiceps* always possess the handle shorter than the blade. In the species *T. ovis* and *T. hydatigena*, large hooks have the handle longer than the blade.

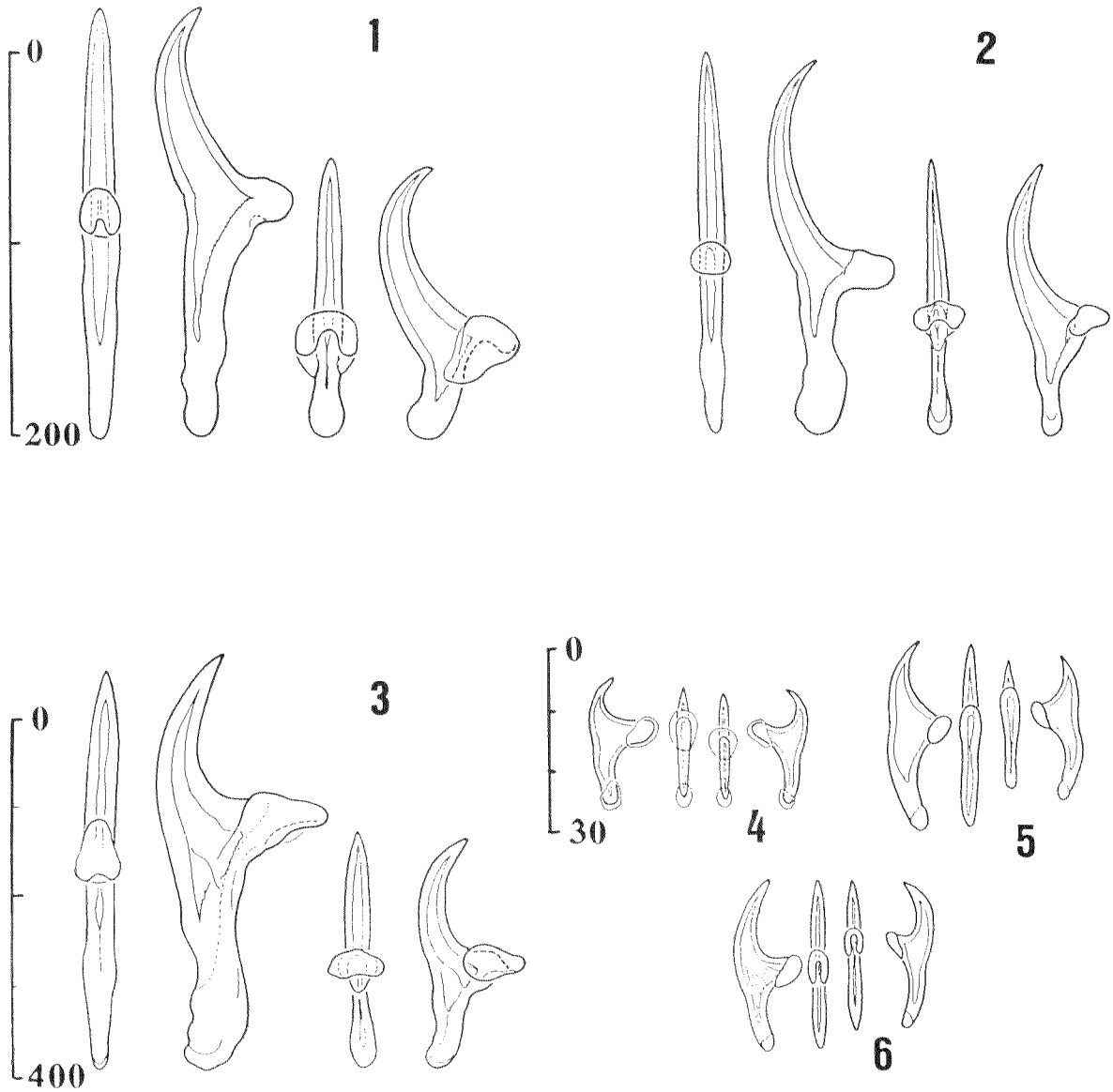

Fig. 1. *Taenia polyacantha* Leuckart, 1856. Fig. 2. *Taenia crassiceps* (Zeder, 1800). Fig. 3. *Taenia taeniaeformis* (Batsch, 1786). Fig. 4. *Taenia mustelae* Gmelin, 1790. Fig. 5. *Cladotaenia globifera* (Batsch, 1786). Fig. 6. *Echinococcus multilocularis* Leuckart, 1863 - after Deblock and Petavy (1983). Large and small hooks (ventral and lateral views) of the larval stages of cestodes in Auvergne. (Figs. 1—5 original)

As to the hook morphology in *T. crassiceps*, we did not find the variability reported by V e r s t e r (1969), but we found the typical hooks as described e.g. by A b u l a d z e (1964), M u r a i (1982), L o o s - F r a n k and Z e y l e (1982), S c h a e r e r (1987) and others. Our finding of *T. crassiceps* cysts in *M. arvalis* lungs is entirely original.

Taenia taeniaeformis (Batsch, 1786) (Fig. 3)
L o c a l i t y: Allanche
H o s t: *M. arvalis*
S i t e: liver.
P r e v a l e n c e: 2.7 %
I n f e c t i o n i n t e n s i t y: 1 specimen.

Notes: We found the cyst of 8 mm in size. Typical stage - strobilocercus inside the cyst. Scolex with hooks 16 x 2. Large hooks measure 0.420 mm, smaller ones are 0.260 mm. Handle of large hooks always longer than blade, the contrary is in small ones.

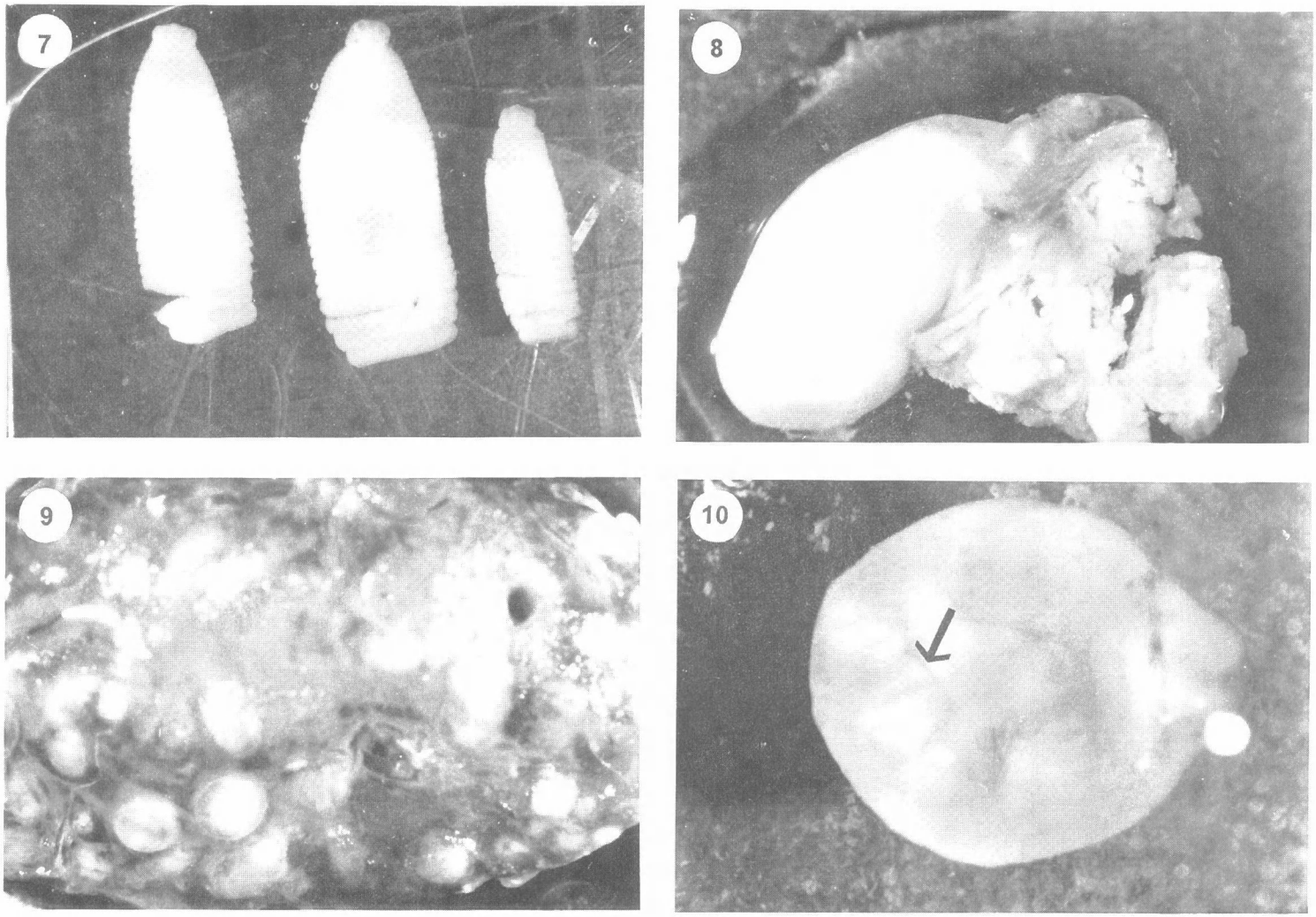

Fig. 7. *Anoplocephaloides dentata* (Galli valerio,1905). Specimens of different sizes from *Arvicola terrestris*. Fig. 8. *Echinococcus multilocularis* (Leuckart, 1863). Specimen from the liver of *Microtus arvalis*. Fig. 9. *Taenia crassiceps* (Zeder, 1800). Numerous cysts parasites of lungs from *M. arvalis*. Fig. 10. *Taenia crassiceps* (Zeder, 1800). Cyst from pleural cavity with the beginning of the daughter cysts (arrow)

In the literature on the species *T. taeniaeformis*, the hook number variability is given as 26—52 (cf. Verster, 1969). Iwaki (1988) and Iwaki *et al.* (1964) even established 3 different strains of *T. taeniaeformis* without ascribing taxonomic value to them.

Within the hook development in *T. taeniaeformis* the forms occur which do not correspond morphologically and metrically to the definitive hook form (cf. Ryzhikov *et al.*, 1978; Tenora and Murai, 1973; Murai, 1982). This fact leads sometimes to confusing the species *T. taeniaeformis* and *T. laticollis* Rudolphi, 1819 (cf. Pfaller and Tenora, 1972; Deblock and Petavy, 1983). Even when a certain affinity is found in various growth phases of hooks in the species *T. taeniaeformis* and *T. laticollis*, the definitive hooks of the species *T. taeniaeformis* are, in comparison with *T. laticollis* always longer, and their handle is typical with its termination (cf. Schmidt, 1961; Verster, 1964; Murai, 1982; Loos-Frank and Zeyle, 1982; Tenora and Kullmann, 1970a, 1970b; Deblock and Petavy, 1993 and others).

Taenia mustelae Gmelin, 1790 (Fig. 4)
Locality: Allanche
Host: *M. arvalis*
Site: liver
Prevalence: 5 %
Infection intensity: 1—2 cysts.

Notes: The cyst shell is formed by the liver tissue. Number of hooks on the scolex 21—23 x 2. Their lengths range from 0.019 to 0.023.

For the species *T. mustelae*, different numbers of hooks on the scolex are given (cf. Freeman, 1956; Verster, 1969; Murai, 1982; Genov, 1984 and others). The total hook number (42—46) in our material approaches the most to the data by Wahl (1967); (37—46 hooks).

The hook morphology in *T. mustelae* is presented by different authors in different ways. The cup-like type with shorter or longer handle predominantes (cf. Freeman, 1956; Murai, 1982; Abuladze, 1964; Deblock and Petavy, 1983).

As to the hook length, similarly to their number and morphology, also there no uniform opinion exists (cf. Verster, 1969). The last author suggests that different hook lengths led the authors to establish more categories within the species *T. mustelae* without ascribing the value a taxonomical unit to them.

As regards the nomenclature, according Freeman (1956), the name *T. mustelae* Gmelin, 1790 has the priority before the name *T. tenuicollis* Rudolphi, 1819. This opinion is accepted generally (cf. Wahl, 1967; Verster, 1969; Ryzhikov *et al.*, 1978; Genov, 1984; Loos-Frank, 1987; Gubanyi *et al.*, 1992; Murai *et al.*, 1992; Pesteur *et al.*, 1992 and others), but it is not valid in each case as it can be seen from the studies by Dollfus (1961), Abuladze (1964), Tenora and Vaněk (1969). Hörning (1971), Murai (1982), Schmidt (1986), Feliu *et al.* (1991) and Miquel *et al.* (1994).

Cladotaenia globifera (Batsch, 1786) (Fig. 5)
Locality: Allanche
Host: *Cl. glareolus*
Site: liver
Prevalence and infection intensity: 1 cyst found in a single host captured.

Notes: The larval stage of the cestode *Cl. globifera* has the cyst of "cladothyridium type" when the parasite forms itself a firm shell (cf. Abuladze, 1964; Hörning, 1971). In our material, the cyst containing the larval stage with the scolex having 21 x 2 hooks was found. Large hooks measure 0.032—0.034 mm, small ones are 0.021—0.0275 mm. These measurements, as well as the hook number are the closest to the data by Kornyushin (1989) (compare in Freeman, 1959; Abuladze, 1964; Murai, 1982; Genov, 1984 and others).

Discussion

The parasitic worms of rodents in the Auvergne district were studied by Deblock and Petavy (1983) and Petavy *et al.* (1984). They dealt with larval stages of cestodes. The results of these authors were confirmed by our findings of *E. multilocularis* in *M. arvalis* and *A. terrestris*. We suggest that the circulation of *E. multilocularis* in the natural focus examined continues permanently. Similarly to Deblock and Petavy (1990) and Petavy *et al.* (1991), we assume that "*M. arvalis* and *A. terrestris* probably serve as intermediate hosts for *E. multilocularis*". In coincidence with the above authors, we also confirmed that the rodents in the Auvergne district are parasitized by larval stages of the cestodes *T. polyacantha*, *T. crassiceps*, *T. taeniaeformis* and *T. mustelae*.

Loos-Frank (1987) in accordance with the results by Murai (1982) drew attention to that Deblock and Petavy (1983), [(as well as Pfaller and Tenora (1972)] had confused the species *T. taeniaeformis* with *T. laticollis*. Under the present knowledge on the developed of *T. taeniaeformis* hooks (cf. Murai, 1982), we confirm this fact. Also the hook variability in *T. crassiceps*, detected by us, corrects the previous incorrect determination of *T. ovis* (cf. Petavy and Deblock, 1980; Deblock and Petavy, 1993).

The hitherto investigation under European condition indicate that, from the genus *Taenia*, the cestodes *T. crassiceps* and *T. polyacantha* show the highest prefe-

rences in *Vulpes vulpes*. This is evident from the studies by Staněk (1963) and Prokopič (1965) in the Czech Republic, Mituch (1962) and Letková *et al.* (1985) in Slovak Republic, Hörning (1971) in Switzerland, Tenora and Murai (1973) in Hungary, Janchev and Ribzhakov (1977) in Bulgaria, Loos-Frank and Zeyle (1981, 1982), Loos-Frank (1987) and Wessbecher *et al.* (1994) in Germany, Petavy and Deblock (1980), Petavy *et al.* (1985, 1990), Deblock *et al.* (1988) in France, and Miquel *et al.* (1994) in Spain. Our findings of larval stages of *T. crassiceps* and *T. polyacantha* in rodents from the Auvergne district only confirm these conclusions.

As regards the cestode structure of *V. vulpes*, Loos-Frank and Zeyle (1981) expressed their opinion: "Unsere untersuchungen haben in bezug auf die Cestoden ergeben, dass der Fuchs (in Würtenberg zumindest) hauptsächlich solche Arten beherberg, die über kleine Nager erwirbt, und fast keine, deren Zwischenwirte Schalenwild und Nutztiere (Rind, Schaf, Schwein) sind". In our case, first of all, the species *T. crassiceps, T. polyacantha* and *T. taeniaeformis* are in question when *V. vulpes* is infected by cestodes, by means of larvae of these cestodes parasitizing rodents. *V. vulpes* can be also the hosts of *T. martis* (*T. intermedia*) of which the intermediate hosts are rodents (cf. Prokopič, 1970; Loos-Frank and Zeyle, 1982; Deblock and Petavy, 1993; Loos-Frank, 1994) and *T. pisiformis* and *T. serialis* of which the intermediate hosts are members of the family Leporidae (cf. Verster, 1969). Under european condition, parasites of *V. vulpes* are probably not the cestodes *T. ovis, T. laticollis* and *T. multiceps*. While in case of *T. ovis* and *T. multiceps*, the intermediate hosts are known (Artiodactyla), in case of *T. laticollis*, the intermediate hosts are not known as far (cf. Abuladze, 1964; Verster, 1969).

Pesteur *et al.* (1992) dealt with the spatiotemporal distribution of some cestodes in a landscape. The set of cestode larval stages (*E. multilocularis, T. crassiceps, T. polyacantha, T. taeniaeformis, T. mustelae* and *Cl. globifera*) in rodents in a single common habitat (pastures close to small forest) points out the possibility of numerous biological cycles of cestodes everywhere their definitive and intermediate hosts occur. In our case, they are rodents and *V. vulpes* in case or *T. crassiceps, T. polyacantha* and *E. multilocularis*, furthermore *Felis catus* f. *domestica* in case of *T. taeniaeformis*, mammals of the family Mustelidae in case or *T. mustelae*, and birds of the order Falconiformes in case of *Cl. globifera*. In the locality under study, all these vertebrates hosts were observed in direct contact with *M. arvalis, A. terrestris* or *Cl. glareolus*, i.e. with intermediate hosts of the above cestodes.

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References

Abuladze, K. I. (1964): *Essential of cestodology*. IV. *Taeniata - Cestodes of animal and man and the diseases they provoke*. Publ. House Nauka, Moscow

Beveridge, I. (1994): Family Anoplocephalidae. In: **Khalil, L. F., Jones, A., Bray, R. A.** (Eds.): *Key to the Cestode parasites of vertebrates*. CAB International

Deblock, S., Petavy, A. F. (1983): Les larves hépatiques de cestodes parasites du grand campagnol *Arvicola terrestris* en Auvergne (France). *Ann. Parasit. hum. comp.*, 38: 423—437

Deblock, S., Petavy, A. F. (1990): Données récentes sur l'épidemiologie de l'échinococcose alvéolaire en France. *Bull. Soc. Path. Ex.*, 83: 242—248

Deblock, S., Petavy, A. F. (1993): *Taenia intermedia* Rud., 1810 et ses crochets chez un renard de Bourgogne (France). *Bull. Soc. Française Parasit.*, 11: 95—101

Deblock, S., Petavy, A. F., Gilot, B. (1988): Helminthes intestinaux du Renard commun (*Vulpes vulpes* L.) dans le Massif Central (France). *Can. J. Zool.*, 66: 1562—1569

Dollfus, R. Ph. (1961): Sur *Taenia tenuicollis* Rudolphi, 1819 et son cystique. *Ann. Parasit. hum. comp.*, 36: 384—396

Erhardová, B., Ryšavý, B. (1955): To the knowlege worms in Muridae and Arvicolidae. *Zool. listy*, 4: 71—90

Feliu, C., Torres, J., Miquel, J., Gisbert, J., Garcia-Perea, R. (1991): Helminthfauna of *Microtus* (*Microtus*) *cabrerae* (Thomas, 1906) (Rodentia: Arvicolidae) in the Iberian Peninsula: Faunistic and ecological considerations. *Ann. Parasit. hum. comp.*, 66: 121—125

Freeman, R. S. (1956): Life history studies on *Taenia mustelae* Gmelin, 1790 and the taxonomy of certain taenioid cestodes from Mustelidae. *Can. J. Zool.*, 34: 219—242

Freeman, R. S. (1959): On the taxonomy of the genus *Cladotaenia*, the life histoires of *C. globifera* (Batsch, 1786) and *C. circi* Yamaguti, 1935 and a note on distinguishing between the plerocercoides of the genera *Paruterina* and *Cladotaenia*. *Can. J. Zool.*, 37: 317—340