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CORRECTIONS IN THE TAXONOMIC POSITION OF THE HELMINTH-FAUNA OF *APODEMUS* SPP. (RODENTIA) IN THE CZECH REPUBLIC

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Abstract

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Since 1955 as yet in the territory of the Czech Republic in 4 species of the genus *Apodemus* (namely *A. flavicollis, A. sylvaticus, A. microps* and *A. agrarius*), 49 species of parasitic worms were registered in total. At their revision, comparing with the modern literature from the last five decades, the author has approached to several corrections. Subjects are, first of all, several opinions on the species from the genera *Plagiorchis*, *Echinostoma*, *Aprostatandrya*, *Catenotaenia*, *Hymenolepis*, *Syphacia*, *Heligmosomum*, *Heligmosomoides*, *Ganguleterakis* and *Aonchotheca*. Of highly characteristic helminths parasitizing *Apodemus* spp. in Czech Republic, they are from the class *Trematoda*: *Brachylaemus recurvus*; from the class *Cestoda*: *Paranoplocephala omphalodes*, *Skrjabinotaenia lobata*, *Catenotaenia* sp., *Hymenolepis straminea*; from the class *Nematoda*: *Syphacia stroma, S. frederici, S. agraria, Heligmosomum pseudocostellatum, Heligmosomoides polygyrus*, *Aonchotheca murissylvatici*, *Calodium hepaticum*, *Trichocephalus muris*; from the class *Acanthocephala*: *Moniliformis moniliformis*. A number of species has to be verified, in a future, by methods of molecular biology.

Rodentia, *Apodemus* spp., Trematoda, Cestoda, Nematoda, Acanthocephala

A wider basis of the independent scientific discipline – helminthology – was established in the territory of former Czechoslovakia in fifties of the last century. In a number of studies published at that time (see References), the attention was also paid to worms parasitizing rodents, among others to the helminths parasitizing the genus *Apodemus*. Among those publications, studies of faunistic character predominate (see the Reference set). At the present, it is needed to evaluate the hitherto knowledge, to remove eventual errors and mistakes and to carry out eventual corrections in systematic-taxonomical assessments. The present study is an appropriate complement of the summarizing study by Asakawa and Tenora (1996) on Nematoda parasitizing *Apodemus* spp.

MATERIAL AND METHODS

The basis of the study submitted is a set of studies on the helminths parasitizing rodents of the genus *Apodemus* that were published from the territory of the Czech Republic since 1955. The data in these studies (see the References to individual findings) are confronted with the science state at the level of knowledge on the present taxonomy and systematic (see References to notes).

RESULTS

Up to the present in the territory of the Czech Republic, the following parasitic worms belonging to the classes Trematoda, Cestoda, Nematoda and Acanthocephala have been registered:

Trematoda

1. *Brachylaemus musculi* (Rudolphi, 1819)
Host: *A. agrarius, A. flavicollis*
References: Tenora (1963, 1964, 1965 a, b), Rupeš (1964)
Note: Rupeš (1964) presents the species under the correct name *Brachylaemus recurvus* Dujardin, 1845.
Reference: Rupeš (1964)

2. *Echinostoma coalitum* Barker et Beaver, 1915
Host: *A. flavicollis*
References: Tenora (1963, 1964, 1965 a, b)
Note: Regards to the complex situation in taxonomy of the genus *Echinostoma* Rudolphi, 1809, the determination *Echinostoma* sp. is correct.
Reference: Tenora and Borkovcová (2003)

3. *Echinochasmus coaxatus* Dietz, 1909
Host: *A. agrarius*
References: Tenora (1963, 1964, 1965 a, b)

4. *Plagiorchis arvicolae* Schultz et Skworzow, 1931
Hosts*: A. flavicollis, A. sylvaticus*
References: Tenora (1963, 1964, 1965 a, b)
Note: Regards to the complex situation in taxonomy of the genus *Plagiorchis* Lühe, 1899, the determination *Plagiorchis* sp. is correct.
Reference: Tenora and Borkovcová (2003)

5. *Plagiorchis proximus* Barker, 1915
Host: *A. flavicollis*
References: Tenora (1963, 1964, 1965 a, b)
Note: Similarly to the previous species, regards to the complex situation in taxonomy of the genus *Plagiorchis* Lühe, 1899, the determination *Plagiorchis* sp. is correct.
Reference: Tenora and Borkovcová (2003)

6. *Plagiorchis* sp.
Hosts: *A. sylvaticus, A. flavicollis*
References: Erhardová and Ryšavý (1955), Jirouš (1985), Tenora and Staněk (1994, 1995)
Note: Regards to the complex situation in taxonomy of the genus *Plagiorchis* Lühe, 1899, the determination is correct.
Reference: Tenora and Borkovcová (2003)

Cestoda

7. *Hydatigera taeniaeformis* (Batsch, 1786), larv.
Hosts: *A. flavicollis, A sylvaticus*
References: Erhardová and Ryšavý (1955), Holišová and Kočis (1955), Tenora and Baruš (1955 a, b), Erhardová (1956, 1958), Tenora (1963, 1964, 1965 a, b), Rupeš (1964), Tenora and Staněk (1994, 1995)
Note: The species belongs to the genus *Taenia* Linnaeus, 1758.
References: Verster (1969), Rausch (1994), Loos-Frank (2000)

8. *Taenia pisiformis* (Bloch, 1780) larv.
Host: *A. flavicollis*
References: Erhardová and Ryšavý (1955), Tenora and Baruš (1955 a), Tenora (1963, 1964, 1965a, b), Tenora and Staněk (1994, 1995)

9. *Taenia polyacantha* Leuckart, 1856, larv.
Hosts: *A. flavicollis, A. sylvaticus*
References: Erhardová and Ryšavý (1955), Erhardová (1956, 1958), Tenora (1963), Tenora and Staněk (1994, 1995)

10. *Taenia crassiceps* (Zeder, 1800), larv.
Host: *A. flavicollis*
References: Tenora and Staněk (1994, 1995)

11. *Taenia tenuicollis* Rudolphi, 1919, larv.
Host: *A. flavicollis*
Reference: Rupeš (1964)
Note: The correct name of the species is *Taenia mustelae* Gmelin, 1970.
Reference: Loos-Frank (2000)

12. *Cladotaenia globifera* (Batsch, 1786), larv.
Hosts: *A. flavicollis*
References: Tenora and Staněk (1994, 1995)
Note: The species is often reported under the incorrect name *Cladotaenia cylindracea* (Bloch, 1712) Lühe, 1910.
Reference: Kornjuchin (1989)

13. *Dilepis undula* (Schrank, 1788)
Host: *A. flavicollis*
Reference: Prokopič (1970a)

14. *Paraplocephala dentata* (Galli-Valerio, 1905)
Hosts: *A. flavicollis, A. sylvaticus*
References: Tenora (1963, 1964, 1965a, b), Jirouš (1985)
Note: The species belongs to the genus *Anoplocephaloides* Baer, 1923.
Reference: Rausch (1976)

15. *Aprostatandrya macrocephala* (Douthitt, 1915)
Hosts: *A. flavicollis, A. sylvaticus*
References: Tenora (1963, 1964, 1965a, b), Prokopič (1970b, c)
Note: The species A. *macrocephala* is not a parasite in rodents in the Czech Republic. Concerned is a species not determined hitherto, which has to be evidenced at present under the mane *Paranoplocephala* sp.
References: Tenora and Zejda (1974), Tenora and

Murai (1980), Genov et al. (1996), Genov (1984), Tenora (1998), Haukisalmi (2003)

16. *Paranoplocephala omphalodes* (Hermann, 1783)
Hosts: *A. flavicollis, A. sylvaticus*
References: Holišová and Kočiš (1955), Tenora and Baruš (1955a), Erhardová (1956, 1958), Rupeš (1964), Jirouš (1985), Tenora and Staněk (1994, 1995)

17. *Catenotaenia pusilla* (Goeze, 1782)
Hosts: *A. flavicollis, A. sylvaticus, A. agrarius*
References: Tenora and Baruš (1955a), Erhardová and Ryšavý (1955), Erhardová (1956, 1958), Tenora (1963, 1964, 1965a, b), Prokopič (1970a, b), Tenora and Staněk (1994, 1995)
Note: The material has to be revised, and at present it has to be registered under the name *Catenotaenia* sp.
Reference: Tenora (1959), Tenora et al. (1992)

18. *Catenotaenia cricetorum* Kirschenblat, 1949
Host*: A. flavicollis*
Note: Tenora et al. (1992) and Haukisalmi and Tenora (1993) elucidate that Cestoda found in the rodents of the genus *Microtus* and *Clethrionomys*, determined as *C. cricetorum*, may belong to the species *C. henttoneni* Haukisalmi et Tenora, 1993. But it is not clear whether the material determined as *C. cricetorum*, found in *A. flavicollis*, belongs to the latter species.
Reference: Tenora (1959), Tenora et al. (1992), Haukisalmi and Tenora (1993)

19. *Skrjabinotaenia lobata* (Baer, 1925)
Hosts: *A. flavicollis, A. sylvaticus*
References: Holišová and Kočiš (1955), Erhardová and Ryšavý (1955), Tenora and Baruš (1955a), Erhardová (1956, 1958), Tenora (1963, 1964, 1965a, b), Rupeš (1964, Prokopič (1970b, c), Tenora and Staněk (1994, 1995)

20. *Variolepis crenata* (Goeze, 1782)
Hosts: *A. flavicollis, A. sylvaticus*
Reference: Prokopič (1970b, c)
Note: The species with a very complicated systematic-taxonomical status, with the original name *Hymenolepis muris-sylvatici* (Rudolphi, 1819), belonging probably to the genus *Microsomacanthus* López-Neyra, 1962.
Reference: Czaplinski and Vaucher (1994)

21. *Hymenolepis horrida* (Linstow, 1901)
Hosts: *A. sylvaticus, A. flavicollis*
Reference: Prokopič (1970c)

22. *Hymenolepis diminuta* (Rudolphi, 1819)
Hosts: *A. flavicollis, A. sylvaticus*
References: Tenora and Baruš (1955a), Erhardová and Ryšavý (1955), Erhardová (1956, 1958), Tenora (1963, 1964, 1965a, b), Prokopič (1970c), Tenora and Staněk (1994, 1995)
Note: The species is not a parasite in rodents of the genus *Apodemus*. The correct name for the material is *H. hibernia* Montgomery J., Montgomery I., Dunn, 1987.
References: Montgomery et al. (1987), Tenora and Staněk (1994, 1995)

23. *Rodentolepis straminea* (Goeze, 1782)
Hosts: *A. flavicollis, A. sylvaticus, A. microps, A. agrarius*
References: Tenora (1963, 1964, 1965a, b), Rupeš (1964), Baer and Tenora (1970), Prokopič (1970c), Tenora and Staněk (1994, 1995)
Note: The species is also designated with the name *Hymenolepis straminea* (Goeze, 1782). Baer and Tenora (1970) included erroneously also the species *H. microstoma* in synonyms of *R. straminea* (Dujardin, 1845).
References: Baer and Tenora (1970), Casanova et al. (2001)

24. *Rodentolepis fraterna* (Stiles, 1905)
Hosts: *A. flavicollis, A. sylvaticus*
References: Erhardová and Ryšavý (1955), Erhardová (1956, 1958), Tenora (1957, 1958), Baer and Tenora (1970)
Note: In Spasski's (1954) conception, this species is considered incorrectly to be a synonym of *R. straminea*. The independency of *R. fraterna* and *R. straminea* was resolved by Baer and Tenora (1970).
References: Spasskii (1954), Baer and Tenora (1970), Tenora and Staněk (1994, 1995)

25. *Rodentolepis asymmetrica* (Janicki, 1904)
Hosts: *A. flavicollis, A. sylvaticus*
References: Erhardová and Ryšavý (1955), Erhardová (1956, 1958), Prokopič (1970a, b), Baer and Tenora (1970), Jirouš (1985)

Nematoda
26. *Porrocaecum* sp., juv.
Hosts*: A. microps, A sylvaticus*
References: Tenora (1963), Prokopič and Genov (1974)

27. *Ganguleterakis micropis* Tenora, 1960
Hosts: *A. microps, A. sylvaticus*
References: Tenora (1960, 1963, 1964, 1965a, b)
Note: The species is likely a synonym of *G. spumosa* (Schneider, 1866).

A revision of the species from the genus *Ganguleterakis* Lane, 1914 is inevitable.

Reference: The author's present opinion.

28. *Ganguleterakis* ?*spumosa* (Schneider, 1866)

Host: *A. agrarius*

References: Tenora (1960, 1963, 1964, 1965a, b)

Note: Concerned is clearly the species *G. spumosa* (Schneider, 1866).

Reference: The author's present opinion.

29. *Aspiculuris tetraptera* Nitzsch, 1821

Hosts: *A. flavicollis, A. sylvaticus*

References: Erhardová and Ryšavý (1955), Holišová and Kočiš (1955), Erhardová (1956, 1958), Tenora (1963, 1964, 1965a, b)

30. *Syphacia obvelata* (Rudolphi, 1821)

Hosts: *A. flavicollis, A. sylvaticus, A. microps, A. agrarius*

References: Erhardová and Ryšavý (1955), Holišová and Kočiš (1955), Tenora and Baruš (1955a), Erhardová (1956, 1958), Tenora (1957, 1963, 1964, 1965a, b), Rupeš (1964)

Note: The species is not a parasite in rodents of the genus *Apodemus*. Details below in the species *S. stroma, S. frederici* and *S. agraria.*

Reference: Quentin (1971), Sharpilo (1973), Tenora and Mészaros (1975)

31. *Syphacia frederici* Roman, 1945

Hosts: *A. flavicollis, A. sylvaticus*

References: Prokopič and Genov (1974), Tenora et al. (1974), Tenora and Staněk (1994, 1995)

Note: The nematode, parasitizing in caecum, is a specific parasite of *Apodemus* spp. In the earlier materials it was confused with the species *S. obvelata.*

References: Quentin (1971), Sharpilo (1973), Tenora and Mészaros (1975)

32. *Syphacia stroma* (Linstow, 1884)

Hosts: *A. flavicollis, A. sylvaticus, A. microps*

References: Prokopič and Genov (1974), Tenora et al. (1974), Tenora and Staněk (1994, 1995)

Note: The nematode, parasitizing in small intestine, is a specific parasite of *Apodemus* spp. It was often confused with the species *S. obvelata*.

References: Quentin (1971), Sharpilo (1973), Tenora and Mészaros (1975)

33. *Syphacia agraria* Sharpilo, 1973

Host: *A. agrarius*

References: Sharpilo (1973), Tenora and Mészaros (1975)

Note: The nematode, parasitizing small intestine, is a specific parasite of *Apodemus agrarius*. In the earlier materials, it was confused with the species *S. obvelata* or *S. frederici*.

References: Sharpilo (1973), Tenora and Mészaros (1975), Tenora et. al. (1974)

34. *Heligmosomum costellatum* (Dujardin, 1845)

Hosts: *A. flavicollis, A. sylvaticus, A. agrarius*

References: Erhardová and Ryšavý (1955), Holišová and Kočiš (1955), Tenora and Baruš (1955a), Erhardová (1956, 1958), Prokopič and Genov (1974), Tenora and Staněk (1994, 1995)

Note: The species, the specific host of which is *Microtus arvalis*, parasitizes also other members of the family *Arvicolidae*. At the present, the correct name of the material from *Apodemus* spp. is *Heligmosomum pseudocostellatum* Tenora, Baruš et Prokeš, 2002.

Reference: Tenora et al. (2002)

35. *Heligmosomum mixtum* Schulz, 1954

Host: *A. flavicollis*

Reference: Prokopič and Genov (1974)

Note: The species does not parasitize *Apodemus* spp. Likely, a change occurred of the etiquet in the host material.

Reference: Prokopič and Genov (1974), Genov (1984), Tenora et al. (2002)

36. *Heligmosomum skrjabini* (Schulz, 1926)

Hosts: *A. flavicollis, A. sylvaticus, A. microps, A. agrarius*

References: Holišová and Kočiš (1955), Tenora and Baruš (1955a, b), Erhardová (1956, 1958), Tenora (1957, 1958, 1963, 1964, 1965a, b), Rupeš (1964), Prokopič and Genov (1974), Tenora et al. (1974), Tenora and Staněk (1994, 1995)

Note: The species has been presented under various names as *Nematospiroides dubius*, *H. aberrans, H. azerbaidjani* or *H. skrjabini*. The taxonomic and systematic status of *H. polygyrum* was resolved by Tenora (1966), Durette-Desset (1968) and Tenora, Baruš and Prokeš (2003). The correct name is *Heligmosomoides polygyrus* (Dujardin, 1845), not *H. skrjabini.*

Reference: Tenora, Baruš and Prokeš (2003)

37. *Heligmosomum aberrans* (Roé, 1929)

Host: *A. flavicollis*

Reference: Tenora and Baruš (1955a)

Note: The species is not a synonym of *H. polygyrus*. The status of incertae sedis belongs to it.

Reference: Tenora et al.(2003)

38. *Heligmosomum azerbaidjani* Schachnazarova, 1949

Host: *A. flavicollis*

References: Tenora and Baruš (1955, 1958), Tenora (1963)

Note: The species is a synonym of the species *H. polygyrus* (Dujardin, 1845).
Reference: Tenora et al. (2003)

39. *Heligmosomoides laevis* (Dujardin, 1854)
Hosts: *A. flavicollis, A. sylvaticus*
References: Erhardová and Ryšavý (1955), Erhardová (1956, 1958), Tenora (1963), Rupeš (1964), Prokopič and Genov (1974), Jirouš (1985), Tenora and Staněk (1994, 1995)
Note: The species is presented in some publications under the incorrect name *H. polygyrus*. The systematic status was resolved by Durette-Desset (1968).
References: Durette-Desset (1968), Tenora and Staněk (1994, 1995)

40. *Boreostrongylus minutus* (Dujardin, 1845)
Host: *A. flavicollis*
Reference: Prokopič and Genov (1974)

41. *Trichostrongylus retortaeformis* (Zeder, 1800)
Host: *A. microps*
Refrences: Tenora (1963, 1964, 1965a, b)

42. *Aonchotheca annulosa* (Dujardin, 1845) López-Neyra, 1947
Hosts: *Apodemus* sp., *A. sylvaticus*
References: Jirouš (1985), Moravec (2000)
Note: In the paper by Jirouš (1985), this species is presented under the name *Capillaria annulosa*.
Reference: Moravec (2000)

43. *Aonchotheca murissylvatici* (Diesing, 1851) López-Neyra, 1947
Hosts: *A. flavicollis, A. sylvaticus*
References: Erhardová and Ryšavý (1955), Tenora and Baruš (1955a), Erhardová (1956, 1958), Tenora (1963, 1964, 1965a, b), Rupeš (1964), Tenora and Zavadil (1967), Prokopič and Genov (1974), Tenora and Staněk (1994, 1955), Moravec (2000)
Note: In the earlier studies, this species is presented under the name *Capillaria muris-sylvatici* (Diesing, 1851); corrected by Moravec (2000).
Reference: Moravec (2000)

44. *Capillaria hepatica* Hall, 1916
Host: *A. flavicollis*
References: Erhardová and Ryšavý (1955), Erhardová (1956, 1958), Prokopič and Genov (1974), Moravec (2000)
Note: The correct name for this species is *Calodium hepaticum* (Bancroft, 1893) Moravec, 1982.
Reference: Moravec (2000)

45. *Thominx bacillata* (Ebert, 1863)
Host: *A. flavicollis*
References: Erhardová (1964), Moravec (2000)
Note: The correct name is *Eucoleus bacillatus* (Ebert, 1863) López-Neyra, 1947.
Reference: Moravec (2000)

46. *Trichocephalus muris* (Schrank, 1788)
Hosts: *A. flavicollis, A. sylvaticus, A. microps, A. agrarius*
References: Erhardová and Ryšavý (1955), Holišová and Kočiš (1955), Tenora and Baruš (1955a), Erhardová (1956, 1958), Tenora (1963, 1964, 1965a, b), Rupeš (1964), Prokopič and Genov (1974), Jirouš (1985), Tenora and Staněk (1994, 1995)

47. *Rictularia proni* Seurat, 1915
Hosts: *A. flavicollis, A. sylvaticus, A. agrarius*
References: Tenora (1963, 1964, 1965a, b)

48. *Mastophorus muris* (Gmelin, 1790)
Hosts: *A. flavicollis, A. sylvaticus*
References: Erhardová (1956, 1958), Tenora (1963, 1964, 1965a, b), Rupeš (1964), Prokopič and Genov (1974)

Acanthocephala
49. *Moniliformis moniliformis* (Bremser, 1811)
Hosts: *A. flavicollis, A. sylvaticus, A. agrarius*
References: Tenora and Baruš (1955a), Erhardová (1956, 1958), Tenora and Staněk (1994, 1995)
Note: To the species, also larval stages *Moniliformis* sp. juv. belong.
Reference: Tenora and Baruš (1955a)

SOUHRN

Korigující poznámky k taxonomickému postavení cizopasných červů rodu *Apodemus* (myšice, hlodavci) v České republice

Od roku 1955 až dosud bylo na území České republiky registrováno ve čtyřech druzích myšic rodu *Apodemus*, a to *A. flavicollis, A. sylvaticus, A. microps* a *A. agrarius* celkem 49 druhů parazitických červů. Při jejich revizi, srovnáním s moderní literaturou posledního půlstoletí, přistoupil autor k některým korekcím. Jsou revidovány především některé názory na parazitické druhy z rodů *Plagiorchis*,

Echinostoma, *Aprostatandrya*, *Catenotaenia*, *Hymenolepis*, *Syphacia*, *Heligmosomum*, *Heligmosomoides*, *Ganguleterakis* a *Aonchotheca*. Z velmi charakteristických helmintů parazitujících v *Apodemus* spp. v České republice se jeví z třídy Trematoda: *Brachylaemus recurvus*; z třídy Cestoda: *Paranoplocephala omphalodes*, *Skrjabinotaenia lobata*, *Catenotaenia* sp., *Hymenolepis hibernia*, *Microsomacanthus muris-sylvatici*, *Rodentolepis straminea*; z třídy Nematoda: *Syphacia stroma, S. frederici, S. agraria, Heligmosomum pseudocostellatum*, *Heligmosomoides polygyrus*, *Aonchotheca muris-sylvatici*, *Calodium hepaticum*, *Trichocephalus muris*; z třídy Acanthocephala: *Moniliformis moniliformis*. Řadu druhů je nutno v budoucnu prověřit metodami molekulární biologie, zvláště druhy z rodů *Plagiorchis*, *Echinostoma*, *Paranoplocephala*, *Aprostatandrya*, *Catenotaenia*, *Heligmosomum* a *Ganguleterakis*.

hlodavci, myšice, *Apodemus* spp., motolice, tasemnice, hlístice, vrtejši

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