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Occurrence of Digenea (Trematoda) in two *Viviparus* species from lakes, rivers and a dam reservoir

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Summary

From the July of 1999 to the end of the year 2000, 1510 snail specimens were investigated. 640 of them were *Viviparus viviparus* (364 females and 276 males from rivers Wieprz and Narew, as well as the Zegrzyńskie reservoir) and 870 *Viviparus contectus* (501 females and 369 males from the Mazurian lakes: Mojtyńskie, Czos, Mokre and Inulec). The results show that 6 species of flukes occur in the areas studied. They are *Neoacanthoparyphium echinatoides* (Filippi, 1854) (synonym *Echinoparyphium petrovi*, (Nevostrueva, 1954), *Paracoenogonimus ovatus* Katsurada, 1914, *Cercaria vesiculosa* (Diesing, 1850), *Cercaria pugnax* (La Valette, 1855), *Leucochloridiomorpha lutea* (Bear, 1827), and *Amblosoma exile* Pojmańska, 1972. All these parasite species occurred in both species of snails investigated. *Neoacanthoparyphium echinatoides* was the most frequent (overall extensity roughly 15 %), followed by *Leucochloridiomorpha lutea* and *Amblosoma exile* (extensity among *V. viviparus* about 6.4 % and 7.5 %, respectively, whereas among *V. contectus* it was 1.7 % and about 2 %, respectively). The occurrence of the remaining trematodes, *Paracoenogonimus ovatus*, *Cercaria vesiculosa* and *Cercaria pugnax* was of a sporadic nature (overall infection extensity was below 2 %). Extensity of infection among snails varied from habitat to habitat and the percentage of infected females was twice that of males. Considering the fact that the females of both snails are more abundant in these habitats than males 1.3:1, their role in the turnover of parasites is three times more than that of males.

Key words: Trematodes; Digenea; developmental stages; Viviparidae; environment

Introduction

There are 15 genera of gastropods belonging to the family Viviparidae occurring in freshwater habitats in the world, with the exceptions of South America (reported in mines) and Antarctica (Piechocki, 1979). They are represented in Poland by two species of the genus *Viviparus*: *V. viviparus* (Linnaeus, 1758) and *V. contectus* (Millet, 1813). Both species are widespread in Poland although not abundant everywhere. *V. viviparus* is the most commonly found in rivers while *V. contectus* mainly prefers lakes and small, stagnant pools of water.

V. viviparus is particularly abundant in the Zegrzyński reservoir, especially at the mouths of rivers Bug and Narew, where they make up 78 % of the 49 species of snails occurring there (Jurkiewicz-Karnkowska, 1986). Samochwalenko and Stańczykowska (1972) noted that over 50 % of the specimens examined in various habitats were infested with larvae of flukes. They observed that infection had a huge influence on the fertility of the population, and this revealed itself by a 2 to 4-fold decrease in embryo development among infected females. The identity of the parasites involved was however not mentioned.

Investigations involving snail parasites have been rarely conducted over the years. Lühe (1909) described from Germany 8 kinds of cercariae infecting *V. viviparus* and *V. fasciatus*. Kozicka and Niewiadomska (1958) determined the annual development cycle of *Poracoenogonimus viviparae* whose adult stage occurs in birds: marsh harrier *Circus aeruginosus* (L.), buzzard *Buteo buteo* (L.), and goosander (*Mergus mengaster* L.). Pojmańska (1971, 1972), described the metacercariae of two species *Amblosoma exile* and *Leucochloridiomorpha lutea,* whose adult forms occur in the tufted duck *Aythya fuligula* (L.). Snail parasite fauna have recently been reported from the river Dniepr (Chernogorenko, 1983): age structure and seasonal dynamics of infection of the *V. viviparus* populations with flukes were assessed (Zhokhov, 1993). The current literature reveals a lack of new data relating to the occurrence of

the Digenea in snails. Furthermore, most descriptions, especially of xiphidiocercariae (order Plagiorchiida) date back to the mid-19th or beginning of the 20th century (refer to Lühe, 1909). These descriptions are very superficial and inadequate for use in any credible identification of species. It is therefore essential to conduct a study involving snails belonging to the same genus occurring in different environments.

Materials and Methods

The investigation was conducted from the July of 1999 to the end of the year 2000 in the Mazurian lakes (Mojtyńskie, Czos, Mokre and Inulec), the artificially heated Gosławskie Lake, rivers Wieprz and Narew, as well as the Zegrzyński reservoir. In total, 1510 snail specimens were investigated (640 *V. viviparus* specimens from rivers Wieprz and Narew, as well as the Zegrzyński reservoir, and 870 *V. contectus* specimens from lakes Mojtyńskie, Czos, Mokre and Inulec –Tab. 1.). In Gosławskie Lake, no snails were found. Snail identification was done according to Piechocki (1979).

In order to obtain cercariae, live snails were placed in clean water in separate containers. The presence of cercariae in the water was checked after 30 minutes. This procedure was repeated 2 – 3 times within a period of one day. A part of the snails was dissected with the aim of assessing metacercarial infection, and developing juvenile stages, as well. The flukes were observed live in a solution of 2 % methyl cellulose or chicken egg protein to expose their excretory system. Silver nitrate slides ($AgNO_3$) were prepared so as to show the nerve endings on the surface of the body (chaetotaxy – an important diagnostic feature). Besides this, a part of the material was conserved in 75 % ethylalcohol, glutaraldehyde, as well as in 4 % formalin for further examinations.

Results

Six species of flukes were found to occur in the snails studied:

Family Echinostomatidae

1. *Neoacanthoparyphium echinatoides* (Filippi, 1854) (synonym *Echinoparyphium petrovi* Nevostrueva, 1954).

Family Cyatocotylidae

2. *Paracoenogonimus ovatus* Katsurada, 1914

Family Brachylaimidae

3. *Leucochloridiomorpha lutea* (Baer, 1827)
4. *Amblosoma exile* Pojmańska, 1972

Order Plagiorchida

5. *Cercaria vesiculosa* (Diesing, 1850)
6. *Cercaria pugnax* (La Valette, 1855)

Three parasite species *Paracoenogonimus ovatus*, *Cercaria vesiculosa*, and *Cercaria pugnax occurred* in snails' only in redial or sporocyst and cercarial stages. *Neoacanthoparyphium echinatoides* occurred in the material in redial, cercarial and metacercarial stages. *Leucochloridiomorpha lutea* and *Amblosoma exile* were found only as metacercariae.

All the parasite species occurred in both snails but with different extensities in the various habitats studied (Tab. 2). The analysis of infection according to sex structure showed that the percentage of infected females was over two times higher in comparison with males (Tab. 3).

The overall infection extensities in snails for the six species of flukes in the habitats studied were different and oscillated between 0.94 % and 16.87 %. In the Zegrzyński reservoir three parasite species were not found, whereas in lakes Czos and Inulec two and three species, respectively, did not occur (Tab. 2). The highest infection extensity

Table 1. Research places and general results

Host	Habitat	Number of examined snails	Extensity of infection
V. viviparus	River Wieprz	340	21.2
	River Narew	150	32
	Zegrzyński Reservoir	150	7.3
V. contectus	Lake Mojtyńskie	180	31.1
	Lake Czos	250	14.4
	Lake Mokre	260	10
	Lake Inulec	180	13.3

Table 2. Extensities of infection of snails with the six species of flukes in various habitats

Host	Habitat	*N. e.*	*P.o.*	*C.v.*	*C.p.*	*L.l.*	*A.e.*
V. viviparus	River Wieprz	17.94	1.47	1.76	2.62	2.05	4.41
	River Narew	24	0.67	0.67	2	21.33	18.67
	Zegrzyński Reservoir	7.33	0	0	0	1.33	3.33
	Total	16.87	0.94	1.09	1.87	6.40	7.50
V. contectus	Lake Mojtyńskie	25.55	0	2.78	3.33	5	7.78
	Lake Czos	14.40	1.60	0.40	1.20	0	0
	Lake Mokre	9.61	1.92	0.77	1.15	2.31	1.15
	Lake Inulec	11.67	1.11	1.67	0	0	0
	Total	14.71	1.26	1.26	1.38	1.72	1.95

N.e. – *Neoacanthoparyphium echinatoides*; *P.o.* – *Paracoenogonimus ovatus*; *C.v.* – *Cercaria vesiculosa*; *C.p.* – *Cercaria pugnax*; *L.l.* – *Leucochloridiomorpha lutea*; *A.e.* – *Amblosoma exile* . Numbers of snails examined in each habitat and of habitat together see Table 1.

among snails with larval flukes was observed in rivers Wieprz and Narew, as well as, in lakes Mojtyńskie and Czos.

Neoacanthoparyphium echinatoides most frequently occurred in both hosts (overall extensity about 15 %, Tab. 2). *Leucochloridiomorpha lutea* and *Amblosoma exile* had an overall infection extensity of 6.4 % and 7.5 %, respectively in *V. viviparus.* Both these species were over three times rarer in *V. contectus*, which, among others, has resulted in their complete absence in lakes Czos and Inulec. The occurrence of the remaining three species *P. ovatus*, *C. vesiculosa* and *C. pugnax* was of a sporadic nature (overall infection extensity below 2 %), and they were not noted in the Zegrzyński reservoir.

Table 3. Sex structure of infected snails

Host	Habitat	Females	Males	Total
	River Wieprz	27.27	12.68	11.25
	River Narew	50	15.38	7.50
V. viviparus	Zegrzyński Reservoir	9.57	3.57	1.72
	total	27.20	11.59	
	Lake Mojtyńskie	26.02	24.56	5.29
	Lake Czos	18.84	8.93	4.14
V. contectus	Lake Mokre	16	4.44	2.99
	Lake Inulec	16.52	7.69	2.76
	total	19.56	9.48	

Numbers of snails examined in each habitat and of habitat together see Table 1

Discussion

Neoacanthoparyphium echinatoides, *Paracoenogonimus ovatus, Leucochloridiomorpha lutea, Amblosoma exile,* are good known species and they were identified without any doubts according to Nevostrueva in Skrjabin and Baschkirova (1956), Kozicka and Niewiadomska (1958) Pojmańska (1971, 1972). Adult forms of two remaining species are not known. *Cercaria pugnax* was identified according to the description and figures of Chernogorenko (1983, Fig. 49). The form determined as *Cercaria vesiculosa* was not reported from *Viviparus* in recent contributions and it is determined according to Lühe (1909, Fig. 169) mainly ba-sed on the shape of the curved xiphidium. However, Zdun (1961) described this form, but from another host, *Bithynia tentaculata* and this determination needs a confirmation. The total number of species presently found in *Viviparus* spp. (six) is considerably smaller than species number re-ported from Ukraine. Although Chernogorenko (1983) re-ported from these hosts the occurrence of only five species, but Zdun (1961) found even 11 species.

According to Stańczykowska (1960), on the Konfederatka sandbanks of the Vistula snail females are more abundant them males (sex ratio 3:1). This advantage was particularly strong in the autumn. In the present work sex ratio was estimated at 1.3:1

The analysis of infected snails according to sex showed the ratio of females to males among *V. viviparus* to be 3.09:1 and among *V. contectus* 2.8:1. So, the role of females in the turnover of parasites in these habitats is roughly three times higher in comparison with that of males.

In a work concerning age structure and seasonal infection dynamics of flukes, Zhokhov (1993) established that *C. pugnax* was the most abundant parasite in the population of *V. viviparus* in the Ukraine. In the present study, however, this species was relatively rare. Its highest occurrence was noted in the Lake Mojtyńskie (overall extensity 3.33 %) but it was completely absent in the Zegrzyński dam reservoir and in the Lake Inulec.

The life cycles of xiphidiocercariae *C. pugnax* and *C. vesiculosa* is still not known. According to Zhokhov (1993), the definitive host of *C. pugnax* can be birds: the black-headed gull *Larus ridibundus* (L.) and herring gull *Larus argentatus* Pontoppidan, or rodents: *Arvicola terrestris* (L.). This problem is unsolved and requires further research.

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