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Bird schistosomes from freshwater snails in Austria, with some notes on current problems (Digenea, Schistosomatidae)

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Introduction

Schistosomes are parasitic flukes of the vertebrate blood system. In Europe, exclusively species parasitizing in birds are known. Their larval stages, cercariae, develop in snail intermediate hosts; once mature, they leave the snail and enter the skin of the final host. Accidently, they are able to penetrate human skin and cause cercarial dermatitis. Therefore, these stages represent a potential health risk to people with different water activities (4).

As the research of bird schistosomes is traditional in the Czech Republic and the knowledge of these parasites in Austria is incomplete, a bilateral research project has been accepted. It was focused on detection of schistosome infections in different snail species from several Austrian localities, with subsequent species determination in a specialized Czech laboratory. An extensive examination of freshwater snails for schistosomes was performed for this purpose.

Material and Methods

Freshwater snails were extensively collected in localities in vicinity of Vienna (April - September), around Salzburg (1 week in May) and near Lake Neusiedl (1 week in April). In order to detect an infection, the snails were separately exposed to intensive illumination in order to promote the emergence of cercariae.

Collected snails and freshly released cercariae were determined; identification of parasites was done under light microscope. Schistosome cercariae (genera *Trichobilharzia* and *Bilharziella*) possess characteristic two eye spots and a typical bifurcated tail which serves for movement in water. Because *Trichobilharzia* species are undistinguishable at the cercarial stage, the infected snails were transported to the collaborating laboratory in Prague in order to infect potential final hosts and recover adult flukes for determination. Ducklings were used for this purpose and the infection method by MEULEMAN et al. (6) was applied. Within 2-6 weeks, the faeces and nasal secrets of ducklings were regularly examined for parasite eggs/miracidia. In patent period, adults were found in species-specific organs and tissues.

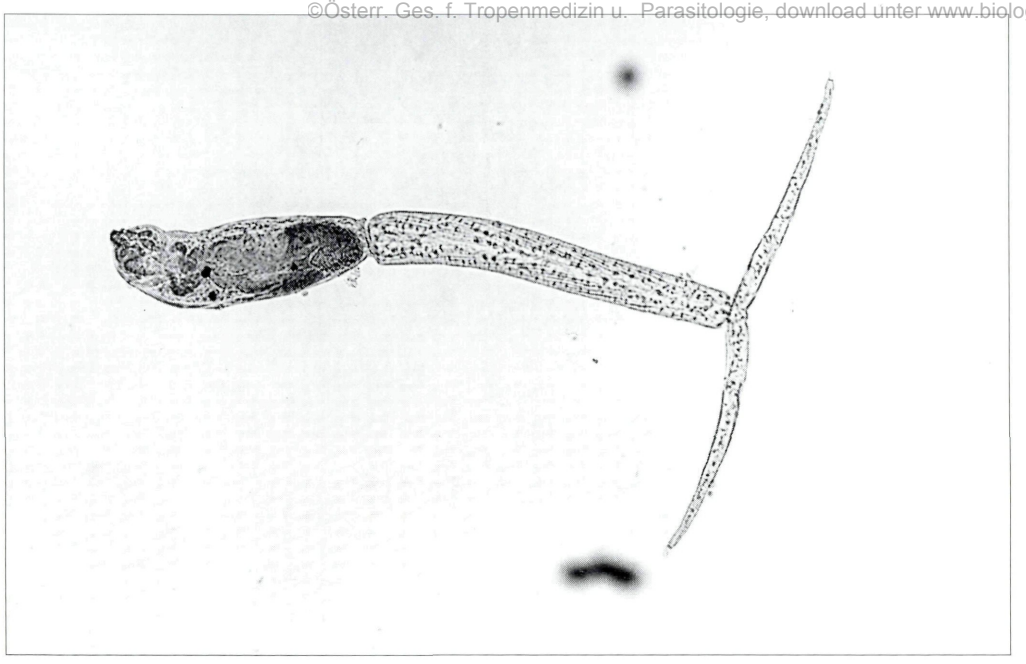


Figure 1:

Trichobilharzia szidati from *Lymnaea stagnalis*, Rekawinkel, Lower Austria (total length appr. 0,9 mm).

Figure. 2:

Bilharziella polonica from *Planorbarius corneus,* Apetlon, Burgenland, Austria (total length appr. 0,6 mm).

Results

In total 5073 snails of 14 species were collected in 20 localities (see Tab. 1 and 2). In four localities, avian schistosomes were found (Fig. 1, 2).

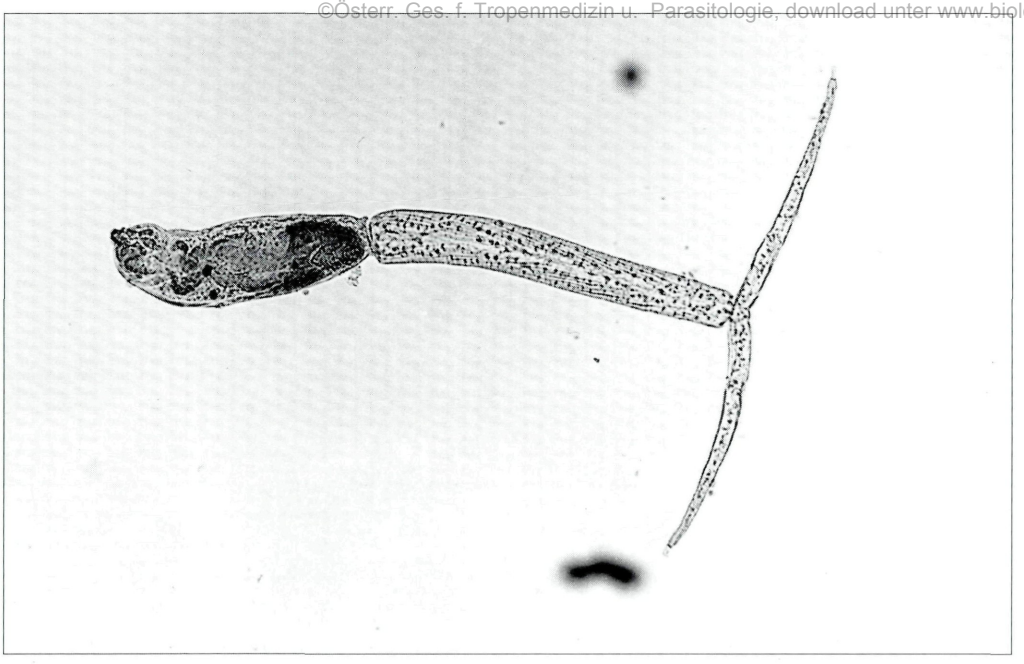
1) *Lymnaea stagnalis*
(Wienerwald – Rekawinkel / Am Hagen):
1st pond (7. 5. 1998)
prevalence 5,2% (n = 96);
5 snails with *Trichobilharzia szidati* NEUHAUS, 1952
2nd pond (7. 5. 1998)
prevalence 6.3% (n = 32);
2 snails with *Trichobilharzia szidati.*

In 7 snail specimens of *L. stagnalis* from two small ponds in the Wienerwald, cercariae of the genus *Trichobilharzia* were found: cercarial dermatitis on the authors' legs and hands developed soon after the contact with emerged cercariae. In ducks infected by cercariae from *L. stagnalis,* adult worms and eggs of *T. szidati* were detected in the intestinal wall.

2) *Radix peregra ovata*
(Schönau - Donau):
10. 6. 1998
prevalence 2.2% (n = 45); 1 snail with *Trichobilharzia* sp.
10. 8. 1998
prevalence 6,1% (n = 33);
2 snails with *Trichobilharzia* sp.

In Danube backwaters, cercariae of the genus *Trichobilharzia* were found twice. Unfortunately, the snails did not survive the transport to Prague and laboratory infection was, therefore, not performed. During collection of snails, the cercariae were able to penetrate human skin and evoke cercarial dermatitis (Fig 1).

3) *Planorbarius corneus*
(Apetlon-canal):
27. 4. 1998
prevalence 3,8% (n = 26);
1 snail with *Bilharziella polonica* Loos, 1899.



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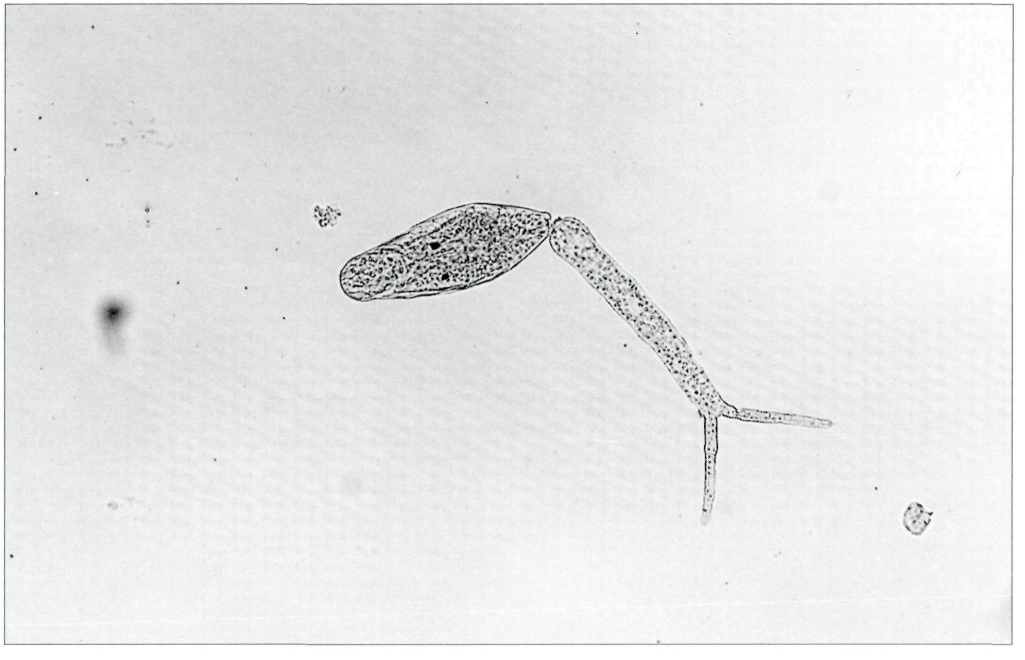

Figure. 2:

Bilharziella polonica from *Planorbarius corneus,* Apetlon, Burgenland, Austria (total length appr. 0,6 mm).

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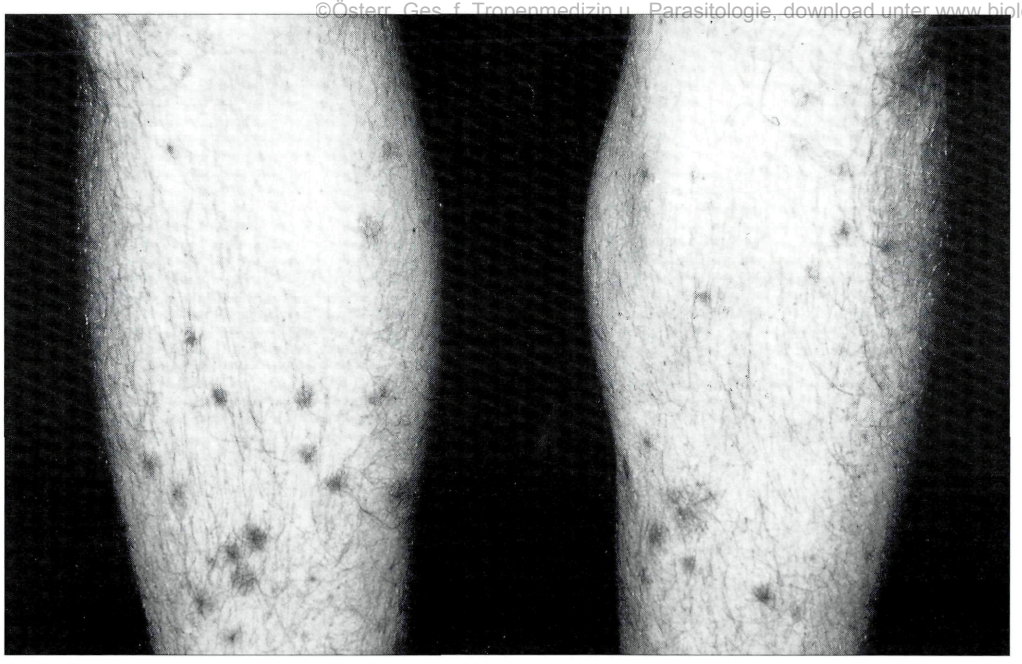

Figure 3:

Cercarial dermatitis from *Trichobilharzia* sp., Schönau/Donau, Lower Austria
(legs of an infected man).

In a water canal near Lake Neusiedl, one infected snail of the species *P. corneus* was found. The snail shed cercariae, morphology of which corresponded to the bird schistosome *B. polonica*. Experimentally, adult males were recovered from the infected ducklings. The finding of *B. polonica* from *P. corneus* is the first report of these larval stages in Austria.

Discussion

Although thousands of snails were examined, only three species of schistosomes in three species of snails were found: *T. szidati* in *L. stagnalis*, *Trichobilharzia* sp. in *R. peregra ovata* and *B. polonica* in *P. corneus*. Of course the chance to detect a schistosome infection depends on the number of snails being available for the parasite infective stages (miracidia) and on the presence of infected final hosts (birds) at the locality. Moreover, the occurrence of snails and schistosome infections may depend also on some environmental factors influencing both, the parasite and the host:

a) First of all, the abundance of snail populations in particular localities and months may vary during the year; this was formerly observed during collection of snails in the Czech Republic (unpublished data). Although infected snails are able to survive the winter period, their number may be reduced in spring months. The development and shedding of cercariae may be delayed and can start first with an increased water temperature. For examination of snails infected by schistosomes, the period May-September may, therefore, be recommended; the beginning of such field search may be delayed mainly in areas where winter period is too long and ponds/lakes are supplied with water from mountains (Salzburg area in our case).

b) The quality of water seems to be an important factor. Changing water levels (e.g., in Danube backwaters) are not suitable for snail reproduction and parasite (schistosome) transmission. As well as, there may exist water characters which can exclude certain snail species from a locality (some localities near Lake Neusiedl with relatively high salinity or eutrophized water with monocultures of *R. auricularia*) (4).

From the epidemiological point of view, waters where cercarial dermatitis occurred represent the most suitable localities for collection of snails with schistosomes. In randomly selected localities, a lower percentage of infections can be expected. Nevertheless, a systematic search for schistosomes in different waters may contribute to recognition of schistosome fauna in the country and enable to make predictions concerning possible risk for recreation activities. Therefore, study of snail infections by schistosomes is up-to-date not only in touristically attractive areas (e.g. Danube backwaters near Vienna, lakes near Salzburg), but also in other parts of the country where plans for a potential use of water resources exist.

If a snail with a schistosome infection is found, the snail and parasite species need to be precisely determined. This is true mainly in view of very recent data which indicate that particular avian schistosomes may cause different clinical symptoms in experimentally infected animals (Horák, Dvorák, Kolárová & Trefil; unpublished). In case of the parasite, we have no reliable criteria for

Table 1:

Survey of localities and collected snail species. (*The collection contained snails shedding schistosomes.)

Locality		Species	number of collected snails
Wien	Lobau/Ölhafen:	*Planorbarius corneus*	177
		Planorbis planorbis	33
		Anisus vortex	3
		Lymnaea stagnalis	8
		Radix peregra sensu lato	71
		Bithynia tentaculata	60
	Lobau/Bahnhof:	*Planorbarius corneus*	42
		Anisus vortex	33
		Segmentina nitida	330
		Lymnaea stagnalis	60
	Lobau/Unkeltümpel:	*Planorbarius corneus*	80
		Planorbis planorbis	21
		Lymnaea stagnalis	53
		Radix peregra sensu lato	2
		Stagnicola spp.	14
		Bithynia tentaculata	2
		Viviparus contectus	59
	Lobau/Bombentrichter:	*Anisus vortex*	64
		Stagnicola spp.	10
		Radix peregra sensu lato	2
		Planorbidae juv.	3
	Lobau/Panozza-Lacke:	*Planorbis planorbis*	29
		Anisus sp.	6
		Radix peregra ovata	20
		Physa fontinalis	10
		Bithynia tentaculata	3
	Wien/Kalksburg:	*Planorbarius corneus*	10
		Lymnaea stagnalis	8
	Wien/Kaisermühlenstraße:	*Planorbis planorbis*	7
		Bithynia tentaculata	45
Niederösterreich	Schönau/Donau:	*Planorbarius corneus*	73
		Planorbis planorbis	51
		Anisus spp.	28
		Gyraulus sp.	24
		Lymnaea stagnalis	120
		Radix peregra ovata	192*
		Radix auricularia	64
		Radix ampla	6
		Physa acuta	193
		Stagnicola spp.	17
		Viviparus contectus	8
		Bithynia tentaculata	16
	Mühlleiten:	*Planorbarius corneus*	34
		Anisus vortex	2
		Stagnicola spp.	3
	Wienerwald/Rekawinkel (pond 1):	*Planorbarius corneus*	136
		Planorbis planorbis	84
		Lymnaea stagnalis	190*
		Radix peregra peregra	12
		Segmentina nitida	8
	Wienerwald/Rekawinkel (pond 2):	*Lymnaea stagnalis*	32*
		Radix auricularia	2

species identification at the cercarial stage at present. There are attempts to use some special techniques for determination of these larvae, e. g., silver staining, scanning electron microscopy, rDNA analysis. As there are either unconvincing results in cercarial discrimination or the methods can hardly be used in medium-level equipped laboratories, the entire life cycle of parasites needs to be completed and the recovered adults identified.

Five genera of schistosomes were described in the Czech Republic (11) and, due to the geographical position, a similar situation may be supposed in Austria. In case of the most frequent genus *Trichobilharzia*, the situation in species composition of this group remains still unclear. There are three sufficiently described species from Europe: *T. szidati* (8), *T. franki* (7) and *T. regenti* (3).

Based on known species specificity of schistosomes to their intermediate hosts (3, 5), it has been concluded that *Trichobilharzia* sp. from Schönau is probably identical to the recently described species – *T. regenti* (3). *T. regenti* has an unusual life cycle: adults live in nasal area of birds where they lay eggs. Miracidia hatch directly in the host tissue. A parasite of this type was found and described in the northern hemisphere for the first time (3).

However, the most popular is *T. ocellata* which was poorly characterized in the original descriptions (2, 5). At present, *T. ocellata* is considered to be a complex of species (1) or it has been proposed by ODENING (9) to synonymize *T. ocellata* with *T. szidati*. Accepting this view or not, the current situation in *Trichobilharzia* intermediate hosts seems to be following: *T. ocellata* / *T. szidati* develops in *L. stagnalis* (9), *T. franki* in *R. auricularia* (7) and *T. regenti* in *R. peregra s. lat.* (3). Findings of *Trichobilharzia* parasites in other snail genera/species need to be studied deeper. A molecular analysis

Locality		Species	number of collected snails
	Wienfluss/Wienerwald:	*Planorbarius corneus*	4
		Gyraulus sp.	10
		Lymnaea stagnalis	1
		Radix peregra sensu lato	32
	Pressbaum (brook):	*Lymnaea stagnalis*	1
		Radix peregra ovata	14
		Physa acuta	35
Burgenland	Apelton (canal):	*Planorbarius corneus*	26*
		Lymnaea stagnalis	1
		Radix peregra ovata	32
	Podersdorf (canal):	*Planorbis planorbis*	8
		Stagnicola spp.	10
		Radix peregra sensu lato	10
		Physa fontinalis	5
		Bithynia tentaculata	7
	St. Andrä/Zicksee:	*Planorbis planorbis*	9
Salzburg	Elsbethen/Salzach:	*Radix peregra ovata*	1423
		Anisus spirobis	9
	Wallersee:	*Planorbarius corneus*	2
		Gyraulus laevis	23
		Bathyomphalus contortus	4
		Stagnicola spp.	115
		Radix peregra peregra	179
		Radix ampla	13
		Bithynia tentaculata	209
	Stadt Salzburg (brook):	*Radix peregra ovata*	394
		Physa acuta	16
	Stadt Salzburg (parks pond):	*Planorbarius corneus*	6
		Lymnaea stagnalis	212

*) The collection contained snails shedding schistosomes.

which is now in progress (10) might help to solve the situation. It may be considered whether species specificity of bird schistosomes toward their intermediate hosts can have a diagnostic value for a routine field screening.

As far as the intermediate hosts of *Trichobilharzia* are concerned, a confusion may be found in genera *Stagnicola* and *Radix*. In our study, the latter genus has been found to serve as *Trichobilharzia* vector in Austria. Two forms (subspecies, species) were distinguished: *R. peregra peregra* and *R. peregra ovata*. However, in some cases, a hybrid morphology of snail shells was found. Therefore, we used the common name *R. peregra* s.lat. in case of doubts, and *R. p. peregra* and *R. p. ovata* in case of clearly expressed morphological types. It should be noted that validity of particular species is currently analyzed by use of molecular methods (MasComa, personal communication).

In conclusion, there is a low prevalence of schistosome infections in snails from Austria. This implies that a search for schistosomes requires an extensive field collection of snails (hundreds and thousands of specimens) in an adequate year season (May-September is recommended). At present, the species identification of schistosomes is possible only by characterization of adult worms; establishment of the life cycle in a laboratory is a necessity for this purpose. The presence of *T. szidati, Trichobilharzia* sp. and *B. polonica* in Austria was demonstrated; *B. polonica* cercariae were found in the country for the first time.

Summary In Austria, in the surroundings of Vienna, Salzburg and Illmitz different freshwater snails were collected and examined for presence of schistosome cercariae which can cause cercarial dermatitis. Schistosome cercariae were found in the following snail species: *Lymnaea stagnalis, Radix peregra ovata* and *Planorbarius corneus*. With cercariae from *Lymnaea stagnalis* and *Planorbarius corneus,* the life cycle using infection of ducks was completed. The snails of the subspecies *Radix peregra ovata* died before schistosome determination. In *L. stagnalis* the schistosome species *Trichobilharzia szidati* was proved. Our finding of *Bilharziella polonica* in *P. corneus* is the first report of these larval stages in Austria. Contrary to the fact that we did not identify the schistosome species from *R. p. ovata,* it may be considered that the parasite differs from *T. szidati/T. ocellata* and *T. franki.*

Key words Trematodes, freshwater snails, *Trichobilharzia, Bilharziella,* cercarial dermatitis, Austria.

Table 2:

Total number of collected snails in Austria with evidence for schistosomes.

Species of snails	Number of snails	Evidence for schistosomes
Lymnaea stagnalis[1])	686	7 x *Trichobilharzia szidati*
Stagnicola spp.	169	0
Radix auricularia	235	0
Radix ampla	19	0
Radix peregra sensu lato[2])	2384	3 x *Trichobilharzia sp.*
Planorbarius corneus[3])	590	1 x *Bilharziella polonica*
Planorbis planorbis	242	0
Anisus spp.	145	0
Segmentina nitida	338	0
Gyraulus spp.	57	0
Bathyomphalus contortus	4	0
Physa fontinalis	18	0
Physa acuta	244	0
Bithynia tentaculata	342	0
Viviparus contectus	67	0
Total	5540	11

[1]) 7 snails shed cercariae of *T. szidati*
[2]) 3 snails shed cercariae of *Trichobilharzia sp.*
[3]) 1 snail shed cercariae of *B. polonica*

Zusammenfassung

Vogel-Schistosomen aus Süßwasserschnecken in Österreich – mit Anmerkungen zu aktuellen Problemen (Dignea, Schistosomatidae)

In Österreich, in Wien und seiner Umgebung, der Stadt Salzburg und ihrer weiteren Umgebung und im Seewinkel/Burgenland, wurden verschiedene Wasserschnecken-Arten gesammelt und auf das Vorhandensein von Zerkarien von Trematoden der Familie Schistosomatidae untersucht, die als Erreger der Zerkarien- oder Badedermatitis in Frage kommen. Schistosome Zerkarien wurden in folgenden Schneckenarten gefunden: *Lymnaea stagnalis, Radix peregra ovata* und *Planorbarius corneus.* Die Zerkarien von *Lymnaea stagnalis* konnten in Enten zur Weiterentwicklung gebracht werden und als *Trichobilharzia szidati* identifiziert werden. Die Zerkarien aus *Planorbarius corneus* wurden ebenfalls in Entenkücken zu geschlechtsreifen Würmern herangezogen und wurden als *Bilharziella polonica* determiniert. Dies ist der erste Nachweis von *Bilharziella polonica* – Zerkarien für Österreich. Die Exemplare von *Radix p. ovata* mit schistosomen Trematoden starben bevor Infektionsversuche zur Weiterentwicklung durchgeführt werden konnten. Auch wenn es nicht gelang, die Trematoden von *R. p. ovata* auf Artniveau zu determinieren, wird angenommen, dass sie von *T. szidati/T. ocellata* und *T. franki* verschieden sind.

Schlüsselwörter Trematoden, Süßwasserschnecken, *Trichobilharzia, Bilharziella,* Badedermatitis, Österreich.

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