

Parasitic fauna of the lake brown trout, *Salmo trutta lacustris* (Salmonidae), a little known endemic fish from Polish waters

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ABSTRACT. The lake brown trout is a salmonids fish regarded as a stationary form of the migratory trout. Within 2003–2004, 31 lake brown trout (*Salmo trutta lacustris* L.) from Lake Wdzydze (Poland), were examined for the presence of parasites following commonly used procedures. The parasites found represented Digenea: *Diplostomum* sp., *Posthodiplostomum cuticola* (Nordmann, 1832), *Sphaerostomum globiporum* (Rudolphi, 1802); Cestoda: *Eubothrium crassum* (Bloch, 1779), *Triaenophorus nodulosus* (Pallas, 1781); Acanthocephala: *Acanthocephalus lucii* (Müller, 1776); Copepoda: *Ergasilus sieboldi* Nordmann, 1832, and Hirudinea: *Piscicola geometra* (Linnaeus, 1761). The overall infection level amounted to 96.7%, 249.4, and 1–440. The copepod *E. sieboldi* was the most frequent parasite (93.5%, 257.4, 64–438). Lake brown trout from the Lake Wdzydze are very heavily infected by parasites dominated by the copepod *E. sieboldi*.

Key words: parasites, lake brown trout, *Salmo trutta lacustris*, Poland

Introduction

The lake brown trout (*Salmo trutta lacustris* L.) is a salmonid fish regarded as a stationary, lacustrine form of the migratory sea trout (*Salmo trutta trutta* L.) or the brown trout (*Salmo trutta fario* L.). It occurs in lakes of north-western Europe, mainly Scandinavia, Ireland, UK, and Russia, and also in alpine and subalpine lakes. In Poland, native populations of the lacustrine brown trout inhabits catchments of rivers Wda, Brda, and Drawa; in addition, the species, due to stocking operations in the past, this species is present in some water bodies in the southern part of the country and in the Suwałki region. The largest population occurs in Lake Wdzydze (Fig. 1) where it is locally known as the Wdzydze trout. The fish grow to the length of 90 cm and weight 3–10 kg. In case of its occurrence rarity, the lake brown trout is not particularly important commercially, despite of its high quality meat [1,2].

The parasite fauna of the Polish lake brown trout is poorly known. But there are a few papers

reporting on studies carried out in 1957–1960 on juveniles (smolts) caught in the Trzebiocha brook discharging into Lake Wdzydze and on adults collected from the Wdzydze [3,4]. In addition, in 1951–1955, Ślusarski [5] studied digeneans in *Salmo* sp. termed the „Wdzydze trout”; thus it may be assumed that he examined individuals of the lake brown trout.

This paper reports on the analysis of the parasitic fauna of the lake brown trout from Lake Wdzydze. The lake is one of the largest in the Pomeranian Lake District. It is located in the Wdzydze Landscape Park, in the river Wda catchment. It is basically a complex of four lakes arranged to resemble an irregular cross, filling the former post-glacial troughs and covering a total area of 1455.6 ha; the mean and maximum depths are 15.2 and 68 m, respectively. The Wdzydze receive the discharge of river Wda and its largest tributary, the Trzebiocha, a spawning area of the lake brown trout [6,7].

Materials and methods

In March 2003, 26 and 2004, 5 individuals of lake brown trout (25–55 cm, 135–1770 g) caught in Lake Wdzydze were examined (Fig. 1). The fish were dissected to perform a standard parasitological examination. Copepods and leeches (previous narcotised in 50% ethanol), were fixed and preserved in 70% ethanol. The *Diplostomum* metacercariae (previous killed in hot water) were fixed in 70% ethanol, and 9:1 mixture of glacial acetic acid and formalin was used to fix the remaining helminths; subsequently, all the helminths were preserved in 70% ethanol. Some parasites were mounted whole: copepods whose mouth parts and legs had been dissected out were embedded in lactophenol, while helminths were stained with Gowers carmine, dehydrated in the alcohol series, cleared in benzyl alcohol, and embedded in Canada balsam.

Results

The study showed total 96.7% of the lake brown trouts have been infected at a mean intensity and intensity range of 249.4 and 1–440, respectively.

Altogether 8 parasitic taxa were found. *Ergasilus sieboldi* represented a dominant species (93.5%, 257.4) (Table 1). Copepods were the only found parasites in fishes captured in 2004.

Due to the large morphological similarity between metacercariae representing different species of *Diplostomum*, identification is very difficult [8]. For this reason, morphometric data [mm] of the two individuals (Fig. 2) collected are reported: body (maximum length and width) first and second specimens, respectively 0.504×0.197, 0.445×0.175; oral sucker 0.047×0.039, 0.055×0.035; length of prepharynx 0.008, 0.004; pharynx 0.031×0.019, 0.031×0.019; acetabulum 0.039×0.043, 0.045×0.043; holdfast organ 0.082×0.070, 0.078×0.070; distance between acetabulum centre and anterior extremity of body 0.312, 0.292; length of pseudosuckers 0.045, 0.043; width of body at level of pseudosuckers 0.105, 0.074; width of body at level of bifurcation of intestine 0.175, 0.154; width of body at level of mid-length of oral sucker 0.187, 0.166; length of lappet 0.012, 0.012. Excretory bodies (498 and 521) of the two individuals were divided into small ($n=30$, 0.0095–0.0096×0.0084–0.0085, mean 0.0095×0.0085) and large groups accounted for 60% of all bodies ($n=30$,

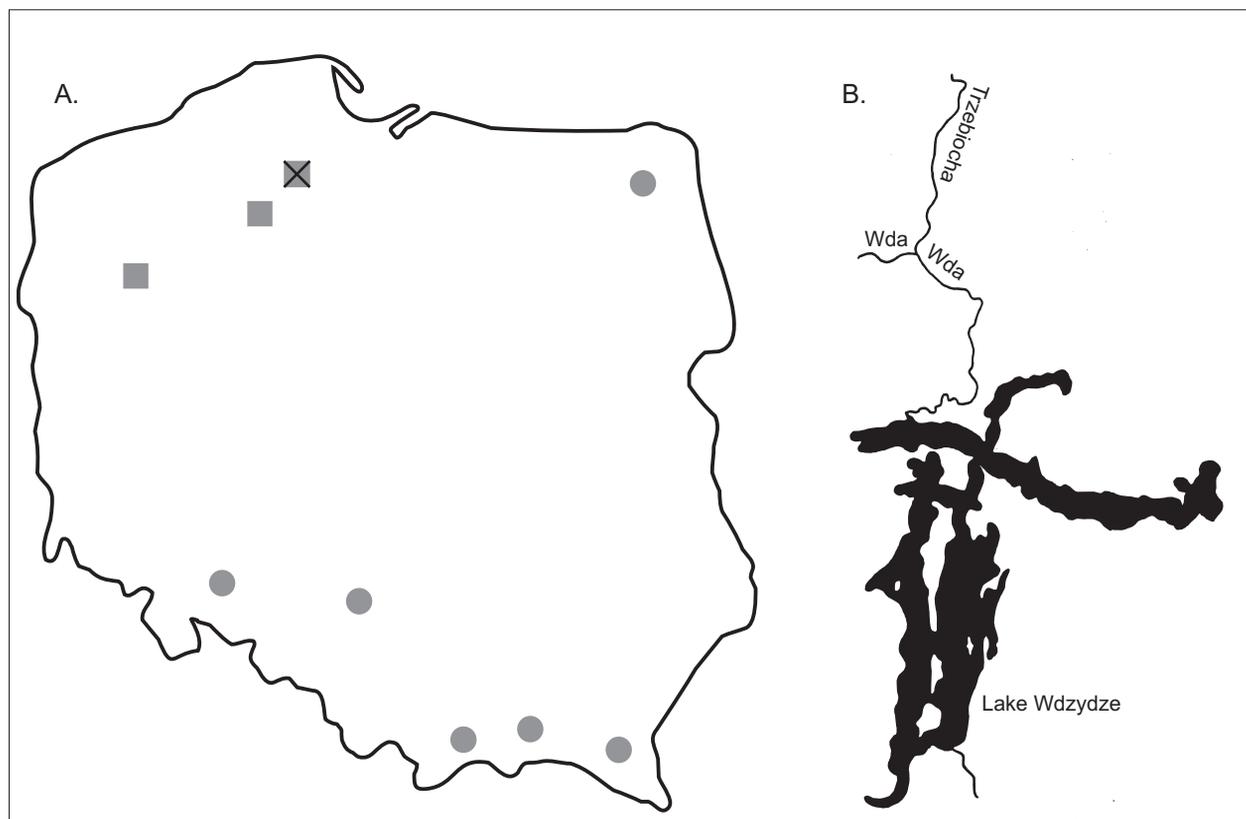


Fig. 1. **A.** The occurrence of lake brown trout in Poland; **B.** Lake Wdzydze with large tributaries
 Explanations: ■ autochthonic populations, ⊠ location of sampling, ● introduced populations

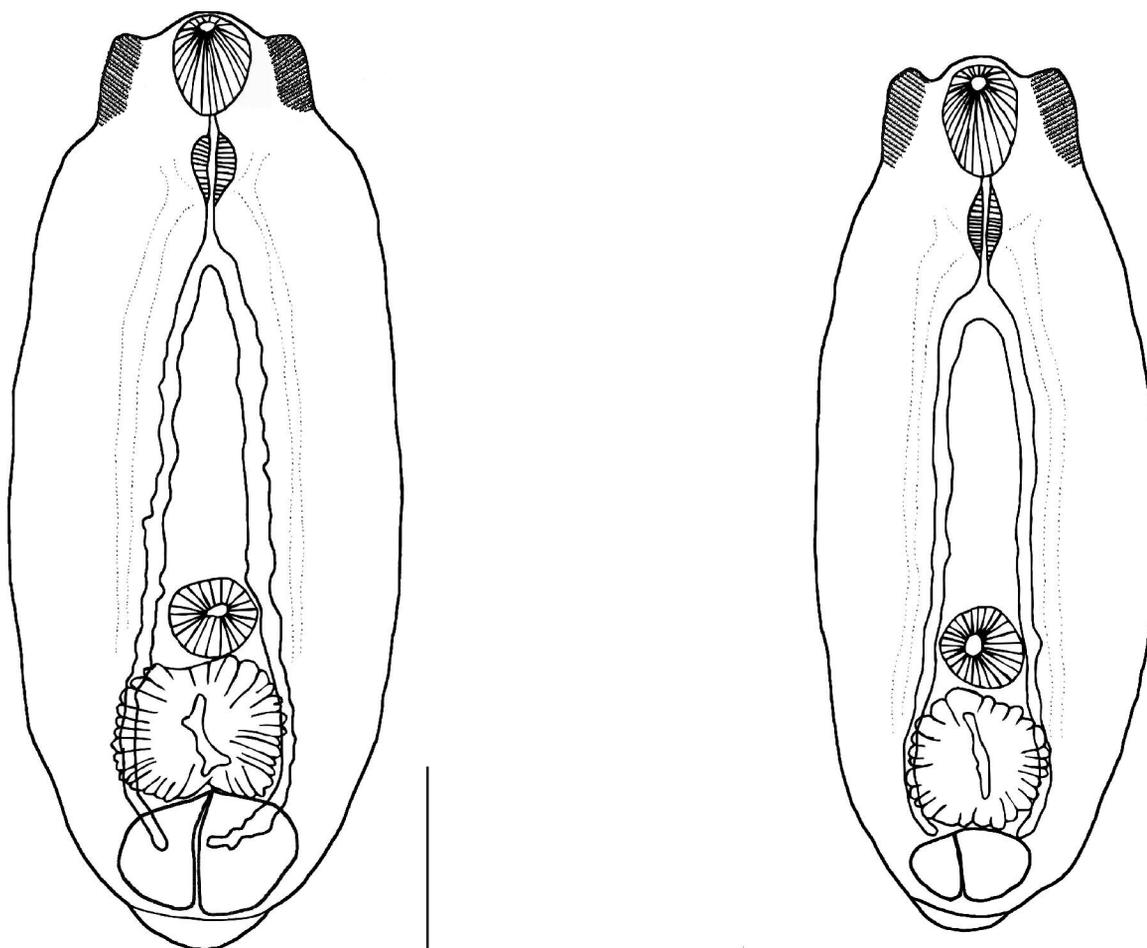


Fig. 2. *Diplostomum* sp. from lake brown trout from Lake Wdzydze. Scale bar: 0.1 mm

0.0123–0.0124×0.0114–0.0115, mean 0.0123×0.0114). They were distributed in three elongated fields. Indices: width/length of body (in %): 39; length×width of body/length×width of holdfast organ: 17.3, 14.3; length×width of body/length×width of acetabulum: 59.2, 40.2; length×width of oral sucker/length×width of acetabulum: 1.1, 1.0; length×width of holdfast organ/length×width of acetabulum: 3.4, 2.8; length×width of oral sucker/length×width of pharynx: 3.1, 3.3; distance between the centre of acetabulum and anterior extremity of body/length of body (in %): 62, 66; width of body at level of mid-length of oral sucker/width of body at level of bifurcation of intestine: 1.1, 1.1.

Discussion

The lake brown trout population studied was found to be very heavily infected, primarily by the

copepod *Ergasilus sieboldi* (93.5%, 257.4); the remaining parasites occurred less frequently by prevalence 3.2–12.9% and the mean intensity of 1.0–2.0 parasites per fish. *E. sieboldi* is common in freshwater fish, and is less frequent in brackish water species (more than 90 species) of numerous families; those preferred include cyprinids, esocids, percids and salmonids [9]. Grabda et. al. [4] who studied fish in the Lake Wdzydze found *E. sieboldi* to be one of the most common parasite. Out of the 13 fish species examined they recorded this copepod in 8 fish species – common bream *Abramis brama* (L.), ruffe *Gymnocephalus cernuus* (L.), vendace *Coregonus albula* (L.), common whitefish *C. lavaretus* (L.), northern pike *Esox lucius* L., roach *Rutilus rutilus* (L.), *S. trutta lacustris*, tench *Tinca tinca* (L.). Lake brown trout was the second (80.0%, 6.5), after tench (88.8%, 50.5), most heavily infected species. Moreover, *E. sieboldi* was a dominant parasite in lake brown trouts. It is worth

Table 1. Parasites of the lake brown trout from Lake Wdzydze

Parasites	Location	Prevalence [%]	Mean intensity	Abundance	Range of intensity
Digenea					
<i>Diplostomum</i> spp., met.	lens	6.4	1.0	0.06	1
<i>Posthodiplostomum cuticola</i> (Nordmann, 1832), met.	gill filament, palate	6.4	1.0	0.06	1
<i>Sphaerostomum globiporum</i> (Rudolphi, 1802)	intestine	12.9	1.0	0.13	1
Cestoda					
<i>Eubothrium crassum</i> (Bloch, 1779)	pyloric caeca	6.4	2.0	0.06	2
<i>Triaenophorus nodulosus</i> (Pallas, 1781), pl.	liver	3.2	1.0	0.03	1
Acanthocephala					
<i>Acanthocephalus lucii</i> (Müller, 1776)	intestine	3.2	1.0	0.03	1
Copepoda					
<i>Ergasilus sieboldi</i> Nordmann, 1832	gill filaments	93.5	257.4	240.8	64-438
Hirudinea					
<i>Piscicola geometra</i> (Linnaeus, 1761)	gill filaments	12.9	1.0	0.13	1
Total		96.7	249.4	241.3	1-440

to add that Grabda et al. [4], found this parasite only in lake brown trouts caught during the period of 1957–58. They did not find this parasite in the fishes captured in 1960. The season of catches is quoted as the most likely reason for such situation. Grabda et al. [4], noted in their findings only about seasons (February, March, May, July, October) of catches within the period 1957–58. Moreover, the data do not include the seasonal dynamic of collected parasites. It may be assumed that lack of copepods in 1960 was related to seasonal occurrence of the parasite. The data presented in this manuscript relate to March. Only 13 copepods had egg sacs out of 7465 collected.

This study revealed the presence of 8 parasitic species in the lake brown trout. Earlier, Grabda et al. [4] also found 8 parasite species that had infected the Lake Wdzydze fish, 3 parasitic species being present in the fish caught in river Trzebiocha. In addition, Ślusarski [5] recorded 4 fluke species in the trout caught from river Wda. It is worth noticing that the lake brown trout in Europe (including those examined in this study) can be regarded as host for a total of 27 valid parasitic species as well as non-identified metacercariae of *Diplostomum* and glochidia [3–5,10] (Table 2). This study provides the second record of the digenean *Sphaerostomum globiporum* and the copepod *E. sieboldi*. These two species had been earlier reported only from the lake brown trout inhabiting Lake Wdzydze and river Wda, *E. sieboldi* being additionally found in river

Trzebiocha [3–5]. In spite of previous data that *S. globiporum* represents a species-specific parasite of roach and rudd *Scardinius erythrophthalmus* (L.), Grabda et al. [4], concluded that this fluke can be a typical parasite of lake brown trout from Wdzydze Lake.

On the other hand, this study provided the first records, in the Lake Wdzydze trout, of *Posthodiplostomum cuticola*, *Eubothrium crassum*, *Triaenophorus nodulosus*, *Acanthocephalus lucii*, and *Piscicola geometra*; besides *E. crassum* and *P. geometra* were found for the first time in the Lake Wdzydze fish. Moreover, in terms of the entire range of the lake brown trout, *P. cuticola*, *A. lucii*, and *P. geometra* represent first host records. *P. cuticola* is a parasite mainly of cyprinids and rarely found in other families' members [11]. *A. lucii* occurs mostly on predator fishes, including salmonids [12]. Whereas, the hirudinean species *P. geometra* has very little marked host specificity; in Europe, it has been reported from more than 30 fish species [13,14].

Due to many factors, lake brown trout, as listed above, represents an endemic and rare species. One of these factors are errors in running a lake brown trout school (e.g., excessive farm catches and breaks in fry-stocking) and deterioration of environmental conditions at the spawning ground, which may be the reason of high mortality of fry [6]. It should not be also forgotten about the negative impact of parasites on health state of fishes and in

Table 2. Variability of lake brown trout parasitic fauna according to various authors

Parasites	Europe		Poland; years of study:		
	[3–5,10], present	1951–55 n=46 [5]*	1957–58 and 1960 n=35 [4]**	1957–58 n=78 [3]***	Present
Monogenea					
<i>Gyrodactylus derjavini</i> ?	+				
<i>Gyrodactylus truttae</i>	+				
Digenea					
<i>Azygia lucii</i>	+	+	+		
<i>Bunodera luciopercae</i>	+	+			
<i>Crepidostomum farionis</i>	+				
<i>Crepidostomum metoecus</i>	+				
<i>Diplostomum spathaceum</i> , met.	+		+	+	
<i>Diplostomum</i> spp.	+				+
<i>Posthodiplostomum cuticola</i>	+				+
<i>Phyllodistomum folium</i>	+	+			
<i>Sphaerostomum globiporum</i>	+	+	+		+
<i>Tylodelphys clavata</i> , met.	+				
Cestoda					
<i>Cyathocephalus truncatus</i>	+				
<i>Diphyllobothrium dendriticum</i> , pl.	+				
<i>Eubothrium crassum</i>	+				+
<i>Proteocephalus neglectus</i> (= <i>P. longicollis</i>)	+		+		
<i>Triaenophorus nodulosus</i> , pl.	+				+
<i>Triaenophorus nodulosus</i>	+				
Nematoda					
<i>Camallanus lacustris</i>	+		+		
<i>Cystidicola farionis</i>	+				
<i>Cystidicoloides ephemeridarum</i> (= <i>Sterliadochona tenuissima</i>)	+		+		
<i>Oswaldocruzia filiformis</i>	+ ****				
<i>Raphidascaris acus</i> , larv.	+				
Acanthocephala					
<i>Acanthocephalus lucii</i>	+				+
<i>Neoechinorhynchus rutili</i>	+		+		
Hirudinea					
<i>Piscicola geometra</i>	+				+
Branchiura					
<i>Argulus coregoni</i>	+				
Copepoda					
<i>Ergasilus sieboldi</i>	+		+	+	+
Mollusca					
Glochidium	+			+	

Explanations: +: parasite reported only from the brown trout from Poland; *: the study focused mostly on juvenile individuals caught in river Wda; **: the study focused on adult individuals caught in Lake Wdzydze; ***: the study focuses on juvenile individuals caught in the Trzebiocha brook; ****: species typical of amphibians and reptilians; according to Moravec [10], it was an accidental infection

consequence, on the state of their stock. Grabda et al. [4], drawn also attention to this fact. *E. sieboldi* seems to be the most dangerous parasite of trout in the Wdzydze Lake. Earlier, prevalence of the parasite infection was 80.0% and the intensity reached 6.5 and 1–17. Infection, at present, increased to 93.5% with high intensity 257.4, 64–438. Such huge infection has an impact on the host.

There is no sufficient data related to qualitative and quantitative fauna of parasites composition of

lake brown trout school. In earlier studies, it was observed that three species of digeneans and single species within cestodes, nematodes, acanthocephalans, and copepods were present. Currently, 3 species of digeneans, 2 species of cestodes, one species of acanthocephalan, copepod and hirudinea were observed; no nematode was found. It is difficult to make a detailed analysis due to the low prevalence of a majority of parasites and small number of studied fish trials. It could be only established that co-

pepod *E. sieboldi* occurs in huge intensification here, in spite of increased lake eutrofization levels from the 50s, in the 20th century [7]. For comparison, Tuuha et. al. [15], observed the highest parameters of infection in fishes captured from oligotrophic waters, and the lowest in chemically or eutrophically contaminated waters. Probably, aroused differences are related to host specificity. Roach and European perch were studied by Tuuha et al. [15].

As already mentioned, it is difficult to assign the *Diplostomum* metacercariae to individual species due to high morphological similarity. Metric characters are highly variable within individual species, and often overlap in different species. Most characters of the two individuals studied in this paper differed from *Diplostomum spathaceum*, previously recorded in trout [3,4]. Thus, it is probable that *Diplostomum* also represent new host record for the lake brown trout.

In summary, it can be concluded that the lake brown trout in Lake Wdzydze is very heavily infected by parasites dominated by the copepod *E. sieboldi*.

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