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First Data on Parasites of the Rotan, *Perccottus glenii* Dybowski, 1877 (Perciformes: Odontobutidae), from Germany, with a Detection of the Previously Unknown Merocercoid of the Gryporhynchid Cestode *Mashonalepis macrosphincter* (Fuhrmann, 1909)

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Abstract: The invasive fish rotan, *Perccottus glenii* Dybowski, 1877 (Odontobutidae), originates from the Far East of Eurasia and presently is known from many European countries including Germany. This undesirable fish has negative impacts on native ecosystems and can be a host to more than hundred parasite species. Here we report records of parasites in young-of-the-year rotans from Charlottenhofer Weihergebiet, an integral nature reserve in the upper part of the Danube basin. Four parasite species were detected: ciliate protozoan *Trichodina nigra* Lom, 1960 as well as cestode merocercoids of *Ophiotaenia europaea* Odening, 1963 (Proteocephalidea), *Mashonalepis macrosphincter* (Fuhrmann, 1909), and *Valipora campylancristrota* (Wedl, 1855) (Cyclophyllidea: Gryporhynchidae). The merocercoid of *M. macrosphincter* is described for the first time. Our data may point to possible interactions of rotan and native reptiles and birds by transmission of parasites in the studied water body. This is the first report devoted to parasites of rotan from Germany.

Keywords: Amur sleeper, Chinese sleeper, invasive alien species, the Danube basin, parasites

Introduction

The fish rotan, known also as Amur sleeper or Chinese sleeper, *Perccottus glenii* Dybowski, 1877 (Perciformes: Odontobutidae) is an invasive species and is rapidly expanding its geographical range in Siberia and Europe (*e.g.,* Koščo *et al*. 1999, Terlecki, Palka 1999, Harka *et al*. 2000, Ćaleta *et al.* 2009, Reshetnikov, Chibilev 2009). More than ten long-distance introductions resulted in appearance of several invaded subranges (Reshetnikov, Ficetola 2011). Spatio-temporal analysis of this expansion confirms that its extensive subrange in East and Central Europe (covering 11 countries) could originate from a single region of initial introduction (since 1960s) in West Ukraine (Reshetnikov 2013). This species demonstrates remarkable negative impact on native hydrobiontes (for a review, see Reshetnikov 2013), especially on amphibians (*e.g*., Manteifel, Reshetnikov 2001). Parasites of rotan were investigated in many points of its invaded range (reviewed by Sokolov *et al*. 2014b, see also Kvach *et al*. 2013, Sokolov, Moshu 2013, Sokolov *et al*. 2014a, Sokolov, Protasova 2014, Kirjušina *et al*. 2014, Sokolov, Novozhilov, 2015, Zaichenko, 2015). However, its parasites had not been studied in river basins of Nemunas, Velikaya, Neva, Northern Dvina, Southern Bug, Ural and Lena. Up to date, there was no information on parasites of

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rotan from Kazakhstan, Belarus, Lithuania, Estonia, Croatia, Bulgaria, Romania and Germany. The investigation of parasite fauna of this invasive species is important for comprehensive understanding of its interactions with native species and its impact on local ecosystems.

The aim of the present study is collecting the first data on parasites of the invasive *P. glenii* in the upper part of the Danube on the territory of Germany. This region is known as the place of the first introduction of *P. glenii* to Germany. Obviously, the rotan was unintentionally imported to aquaculture ponds with fish stock material, at least in the beginning of 2000s and fist recorded in Germany in 2009 (Reshetnikov, Schliewen 2013). We regard appearance of Bavarian population of *P. glenii* as a result of possible secondary unintentional translocation within so-called West-Ukrainian invaded subrange of this species (Reshetnikov 2013).

Material and Methods

Fish samples were collected on August 18, 2014, with landing-net in a semi-natural Brundlweiher Lake (49°21′57″N; 12°10′12″E) in the Charlottenhofer Weihergebiet Integral Nature Reserve in the upper part of the Danube basin, Bavaria, Germany. The collected material was preserved in 96% ethanol and investigated in laboratory conditions under microscope. We examined 25 individuals of young-of-the-year rotans with total length 22–38 mm. The fishes were examined using the standard methods, following Bykhovskaya-Pavlovskaya (1985). Smears with trichodinids were air-dried and then were impregnated with silver nitrate in order to reveal details of the adhesive disc. Cestode larvae were stained with acetocarmine. One specimen of *Mashonalepis macrosphincter* (Fuhrmann, 1909), without colouring, was processed by 15% solution of SDS (Harris *et al*. 1999) for separation of rostellar hooks from soft tissues. The parasite population descriptors (prevalence, abundance and intensity of infection) were calculated using generally accepted methods (Bush *et al*. 1997). In the following description, measurements are given in micrometers.

Results and Discussion

We detected 4 species of parasites: the ciliate protozoan *Trichodina nigra* Lom, 1960, a species infecting a wide range of freshwater fish species (Stein, 1984), as well as cestode merocercoids of the proteocephalidean *Ophiotaenia europaea* Odening, 1963 and the gryporhynchid cyclophyllideans *Mashonalepis macrosphincter* (Fuhrmann, 1909) and *Valipora campylancristrota* (Wedl, 1855) (Table 1).

Merocercoids of *M. macrosphincter* (Fig. 1) had 20 rostellar hooks arranged in two circles, each of 10 hooks. Anterior hooks: total length 45–46, blade 12–13 long, guard 13–14 long, handle 24–25 long, blade/handle ratio 0.49–0.53. Posterior hooks: total length 42, blade 11–12 long, guard 12 long, handle 22–23, blade/handle ratio 0.48–0.54. This larva is similar to *Dendrouterina macrosphincter* (Fuhrmann, 1909) in the number, shape, and size of rostellar hooks (see Bona 1975). The adult stage of this cestode species is intestinal parasite of European ciconiiform birds such as black-crowned night heron *Nycticorax nycticorax* (L.), squacco heron *Ardeola ralloides* (Scopoli), great egret *Ardea alba* L., purple heron *Ardea purpurea* (L.) and grey heron *Ardea cinerea* L. (Ardeidae) (see Bona 1975). Kornyushin, Greben (2014) moved this species to the genus *Mashonalepis* Beverley-Burton, 1960. The present finding is the first report of the merocercoid of *M. macrosphincter*.

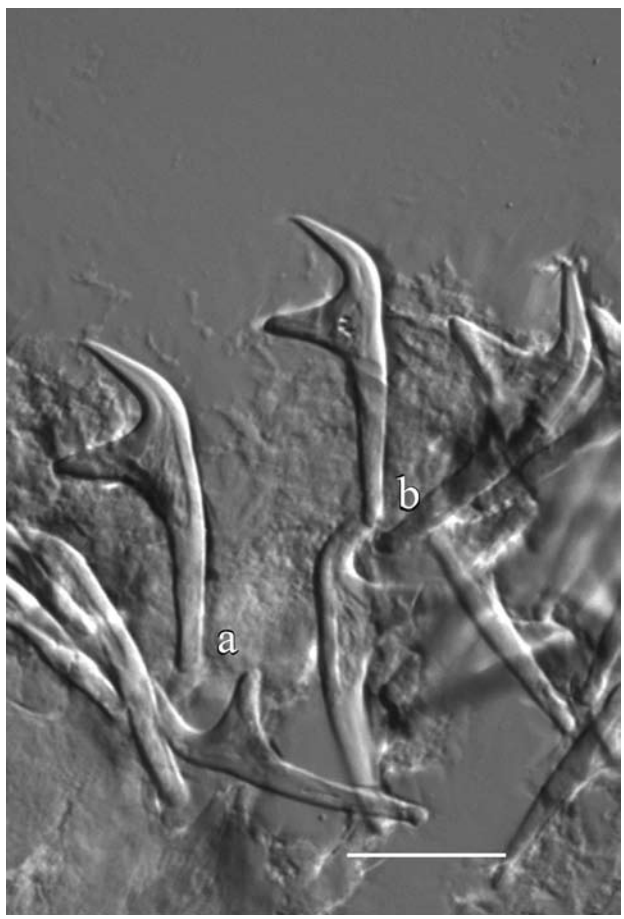

Fig. 1. Rostellar hooks of merocercoid of *Mashonalepis macrosphincter* (Fuhrmann, 1909) from the gall bladder of *Perccottus glenii* from Germany: a = anterior hook; b = posterior hook. Scale bar = 20 μm

Table 1. Occurrence of parasites in *Perccottus glenii* from Charlottenhofer Weihergebiet Integral Nature Reserve, Bavaria, Germany (n = 25)

Parasite	Site of infection	Prevalence, %	Intensity, ind.	Mean abundance
Trichodina nigra	gills	68.0	–	–
Ophiotaenia europaea	mesentery	8.0	1	0.08±0.06
Mashonalepis macrosphincter	gall bladder	4.0	1	0.04±0.04
Valipora campylancristrota	gall bladder	4.0	1	0.04±0.04

Merocercoid of *V. campylancristrota* can infect many European fish species (Scholz *et al*. 2004). The present study is its first report from rotan. In contrast to above-mentioned species, the ciliate *T. nigra* and the merocercoid of *O. europaea* had been reported from rotan within its invaded geographical range earlier (Kvach *et al*. 2013, Sokolov, Moshu 2013, Sokolov *et al*. 2013, 2014a, 2014b). The studied fish species may be both second intermediate host (young-of-the-year fish) and paratenic host (elder fish) for *O. europaea* merocercoids (Sokolov *et al*. 2011). In the first case, fish becomes infected by ingesting infected copepods, which are the first intermediate host for this parasite (Biserkov, Genov 1988, Biserkov, Kostadinova 1997); in the second case (elder fish), infection happens through cannibalism (Sokolov *et al*. 2011). In view of the small size of the examined specimens of the host and the site of infection of these parasites (Table 1), the studied fish individuals are the second intermediate hosts for this cestode species (Sokolov *et al*. 2011). The definitive hosts for *O. europaea* are snakes, mainly semi-aquatic grass snake *Natrix natrix* (L.) and dice snake *Natrix tessellata* Laurenti. In some water bodies, rotan is known to be the only vector of this cestode to snakes (Reshetnikov *et al*. 2013).

We did not find host-specific parasites for rotan within the studied sample. Some of host-specific parasites (*e.g*., nippotaenidean cestode *Nippotaenia mogurndae* Yamaguti et Miyata, 1940) may serve as indicator of a vector of rotan introduction (Reshetnikov *et al*. 2011). The presence of *N. mogurndae* in rotans from Charlottenhofer Weihergebiet could be a confirmation of previously made assumption concerning introduction of this fish in Bavarian waters with fish stock material and reject the aquarium releasing version. Therefore, the examination of the parasite fauna of *P. glenii* from that location should be continued.

Thus, we documented that the invasive fish *P. glenii* had become a host for at least 4 parasite species in the upper part of the Danube river basin on the territory of Germany. This indicates establishment of parasitological interactions between rotan and local reptiles (*Natrix* spp.) and ciconiiform birds. These natives are known to be consumers for rotan (*e.g*., Bakka, Doronin 2001, Reshetnikov *et al*. 2013) and consequently can obtain appropriate parasites through this fish species.

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