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HELMINTH FAUNA OF *PERCA FLUVIATILIS* FROM BATAK RESERVOIR

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Abstract

During the summer of 2018, 18 specimens of European perch (*Perca fluviatilis* (Linnaeus, 1758)) from Batak Reservoir were examined with standard techniques for parasites. All examined *P. fluviatilis* (100%) were infected with one helminth species of the class Cestoda – *Proteocephalus percae* (Linnaeus, 1758). All established helminth specimens were young, with pronounced strobilation, but not sexually mature. The largest number of helminth specimens found in one specimen of host is 22.

The establishment of only one parasite species – *Proteocephalus percae* in all examined fish specimens clearly indicates that its intermediate host is widespread in the Batak Reservoir. This study clearly shows that further research is needed for other host species as well as invertebrates from the Batak Reservoir to make a clear assessment of the ecological status of the freshwater ecosystem.

Keywords: *Perca fluviatilis*, *Proteocephalus percae*, Batak Reservoir, fish parasites.

INTRODUCTION

Every freshwater ecosystem is characterized by certain features that distinguish it from others. Parasites and fish parasite communities have an extraordinary role in the dynamic environment and in the host-parasite system. Their study is of primary importance for the assessment of their ecological status, the conservation and sustainable use of aquatic ecosystems and their resources. Endoparasitic species are interesting indicators of the ecological status of ecosystems because of their complex life cycles and the fact that they indicate for their host's trophic position (Marcogliese, 2005).

Batak Reservoir is one of the largest water collectors in Bulgaria (Michev and Stoyneva, 2007). The algal flora, benthos, phytoplankton, zooplankton and fish species composition of Batak Reservoir were thoroughly studied (Naidenov, 1964; Dimitrov, 1967; Saiz, 1977; Michajlova, and Marinov, 1979; Dochin et al., 2018; etc). Not only the fish species composition was studied, but also their age composition, growth rate, maturity, spawning, sex ratio and feeding (Michajlova, and Marinov, 1979; Raikova-Petrova et al., 1993; Raikova-Petrova and Zivkov, 1998, 2000; Zivkov et al., 2003). In contrast with that the data on fish parasites from Batak Reservoir is scarce (Margaritov, 1964; Tsolov and Ivanov, 1977; Grupcheva, 1983).

Insufficient research of the biodiversity of parasites of freshwater fish species from Batak Reservoir evokes the interest and need of the present study. The aim of this research is to study the helminth fauna of European perch (*Perca fluviatilis* (Linnaeus, 1758)) from Batak Reservoir, Bulgaria.

MATERIALS AND METHODS

During the summer of 2018, fish and fish parasites are collected and examined from Batak Reservoir (41.9663 N, 24.1856 E). Batak Reservoir is situated 4 km away from the town of Batak, 7 km. from the town of Rakitovo and 12 km from the town of Velingrad (Fig. 1). It was built on the Mutnitsa River in 1959. Batak Reservoir was built on former large wetlands and is one of the largest water collectors (2079 ha), located in mountains at Middle Altitudes (600–1800 m a.s.l.) (Michev and Stoyneva, 2007). It belongs to the big reservoirs of national significance listed in Appendix 1 to the Water Act (Anonymous, 1999).

Batak Reservoir is characterized by thick layers of bottom sediments, richness in organic matter and lack of water vegetation due to the big depths and reservoir drawdown (Kozuharov and Naidenov, 1979).

The ichthyofauna of Batak Reservoir is presented with the following species: *Anguilla anguilla, Alburnus alburnus, Aspius aspius, Barbus cyclolepis, Carassius carassius, Carassius gibelio, Ctenopharyngodon idella, Cyprinus carpio, Gobio gobio, Hypophthalmichthys molitrix, Leuciscus cephalus, Rhodeus amarus, Rutilus rutilus,*

Fig. 1. *Batak Reservoir*

Scardinius erythrophthalmus, Tinca tinca, Vimba melanops, Cobitis strumicae, Silurus glanis, Esox lucius, Coregonus albula, Hucho hucho, Oncorhynchus mykiss, Salmo salar, Perca fluviatilis, Sander lucioperca (Stefanov and Trichkova, 2006).

A total of 18 specimens of European perch (*Perca fluviatilis* (Linnaeus, 1758)) were collected and examined from the Batak Reservoir during the summer of 2018. *Perca fluviatilis* is one of the most common fish species in Bulgarian Reservoirs and in most of them the dominant predator (Trichkova et al., 2005; Trichkova et al., 2007). *Perca fluviatilis* is estimated as least concern species (LC=Least Concern; IUCN Red List Status). European perch is freshwater, demersal, anadromous fish species. This fish species inhabits a very wide range of habitats from estuarine lagoons, lakes of all types to medium-sized streams (Fröse and Pauly, 2018). Small juveniles usually feed on zooplankton, the adults with bottom invertebrates and only the largest fish specimens with small fish (Karapetkova and Zhivkov, 2010). *Perca fluviatilis* grows relatively slowly, especially in case of overpopulation of waterbodies of this species, which is a frequent phenomenon (Karapetkova and Zhivkov, 2010).

The European perch (*Perca fluviatilis* (Linnaeus, 1758)) specimens chosen for examination were weighed (total weight from 60-150 g) and measured (total length from 18–23 cm). The fish were immediately after their capture examined for gastrointestinal and tissue helminths (an incomplete parasitological study). Helminthological examinations were carried out following recommendations and procedures described by Bauer et al. (1981), Bykhovskaya-Pavlovskaya (1985), Georgiev et al. (1986), Moravec (1994, 2001), etc. Main parameters of infection (prevalence %, mean abundance, mean intensity) are determined (Bush et al., 1987).

RESULTS AND DISCUSSION

During the summer of 2018, 18 specimens of *P. fluviatilis* from Batak Reservoir were studied for parasites. Helminths ware found in all 18 specimens of fish (100%). Only one helminth species of the class Cestoda – *Proteocephalus percae* (Linnaeus, 1758) was found. All established helminth specimens are young, with pronounced strobilation but not sexually mature. *Proteocephalus* percae is an autogenic parasite species maturing in fish (Moravec, 1994). It is a widespread parasite of *Perca fluviatilis,* which is also its final host. Planktonic crustaceans from the families Diaptomidae and Cydopidae serve as intermediate hosts for Proteocephalus tapeworms (Scholz, 1999). As the only helminth species found in all studied specimens of European perch, *P. percae* has a prevalence of 100% (P% = 100) and mean abundance equal to mean intensity MA±SD=MI±SD=5.72±5.43. The largest number of helminth specimens found in one specimen of a host is 22 (Table 1).

Table 1. Helminth fauna of *Perca fluviatilis* from Batak Reservoir (N – number of examined hosts, n – number of infected hosts, p – number of parasites, P – prevalence, MI – mean intensity, MA – mean abundance)

Helminth species	N=18				
	n	p	MI±SD	MA±SD	Range
Proteocephalus percae	18	103	5.72±5.43	5.72±5.43	1–22

Proteocephalus percae is a specific parasitic species for *Perca fluviatilis* and other *Percidae* species. It is also found in predatory fish such as *Lota lota* and *Essox lucius,* which have become infected after eating infected with *P. percae* European perch. *L. lota* and *E. lucius* are not definitive hosts, but postcyclic (Scholz and Hanzelova, 1998).

Overall, according to Scholz and Hanzelova (1998), distinctive features of *P. percae* are the small, tapering anteriorly scolex without a clearly defined neck region; mature proglottides, which are rather wider than long; the long cirrus sac; as well as the well-developed vaginal sphincter.

The life cycle of the cestode *Proteocephalus percae* was studied by Wootten (1974) both experimentally and in a natural condition in Hanningfield Reservoir, Essex. The author infected experimentally copepods of *Cyclops (Eucyclops) agilis*, *C. (Mesocyclops) leuckarti* and *C. (Acantftocyclops) viridis* with eggs of *P. percae*. Eggs hatch in the intestine, the embryo penetrates the intestinal wall by dint of its hooks and most likely by secretions from its glands, and the larvae develop into the haemocoel. Wootten (1974) found that the copepod species differed in their suitability as hosts for *P. percae* larvae and that development took 3–4 weeks at 14°C in *C. viridis*, but the rate of development varied at different temperatures. The occurrence and maturation of *P. percae* in *P. fluviatilis* is related to an annual cycle. The egg production is carried out in spring, after that the host loses the adult cestodes and shortly after that the juvenile appear (Wotten, 1974).

According to to a number of authors in the lentic freshwater ecosystems, some environmental factors such as water surface area, isolation from other water bodies, pH have a significant impact on the structure of the freshwater invertebrates communities as well as the taxonomic composition and functional structure of the ichthyofauna (Tonn and Magnuson, 1982; Rahel, 1986; Bendell and McNicol, 1987; Wellborn et al.., 1996; Rodriguez and Lewis, 1997). The structure and functioning of macrozoobenthos, zooplankton and fish communities depend directly on limiting environmental factors and reflect the type and intensity of anthropogenic pressure on aquatic ecosystems. The trophic structure of the communities and the nutritional relationships within and between them are the main expressions of the functioning of ecosystems.

European perch is generalist feeder, with food menu including species from different trophic levels as algae, zooplankton, benthic invertebrates and fish (Behrmann-Godel and Brinker, 2016).

According to Dochin et al. (2018), Batak Reservoir is characterized by relatively rich algal flora (106 taxa) which has pronounced seasonal variation.

For the Batak Reservoir, Pandourski (2006) reported the following species of crustacean: *Daphnia pulex* (Leydig, 1860); *Daphniacurvirostris* (Eylmann, 1887); *Daphnia longispina* (Müller, 1776); *Daphnia hyalina* ((Leydig, 1860); *Daphnia cucullata* (Sars, 1862); *Ceriodaphnia reticulata* (Jurine, 1820); (Müller, 1785); *Simocephalus vetulus* (Müller, 1776); *Moina rectirostris* (Leydig, 1860); *Bosmina longirostris* (Müller, 1785); *Bosmina longicornis* (Schödler, 1866); *Bosmina coregoni* (Baird, 1857); *Euricercus lamellatus* (Müller, 1785); *Acroperus harpae harpae* (Baird, 1837); *Alona quadrangularis* (Müller, 1785); *Alona costata* (Sars, 1862); *Alona rectangula* (Sars, 1862); *Rhynchotalona rostrata* (Koch, 1841); *Leydigia leydigii* (Leydig, 1860); *Graptolebris testudinaria* (Fischer, 1848); *Alonella nana* (Baird, 1850); *Chydorus ovalis* (Kurz, 1874); *Chydorus sphaericus* (Müller, 1785); *Diaphanosoma brachyurum* (Lievin, 1848); *Eudiaptomus vulgaris* (Schmeil, 1898); *Macrocyclops fuscus* (Jurine, 1820); *Macrocyclops albidus* (Jurine, 1820); *Eucyclops serrulatus serrulatus* (Fischer, 1851); *Eucyclops serrulatus proximus* (Lilljeborg, 1901); *Paracyclops fimbriatus* (Fischer, 1853); *Tropocyclops prasinus* (Fischer, 1860); *Cyclops strenuus strenuus* (Fischer, 1851); *Cyclops*

abyssorum tatricus (Kozminski, 1927); *Cyclops vicinus* (Uljanin, 1875); *Megacyclops viridis* (Jurine, 1820); *Acanthocyclops vernalis vernalis* (Fischer, 1853); *Acanthocyclops robustus* (Sars, 1863); *Diacyclops bicuspidatus* (Claus, 1857); *Mesocyclops leickarti* (Claus, 1857); *Thermocyclops dybowskii* (Lande, 1890); *Canthocamptus staphylinus staphylinus* (Jurine, 1820).

Vidiniva (2006) reported for two species of mayflies (order Ephemroptera) from Batak Reservoir – *Siphlonurus aestivalis* (Eaton, 1903) and *Siphlonurus armatus* (Eaton, 1870).

Georgiev (2014) reported for two species of gastropoda from Batak Reservoir – *Viviparus acerosus* (Bourguignat, 1862) and *Ancylus fluviatilis* (Müller, 1774).

Margaritov (1964) studied 10 species of fish from Batak reservoir and reported 34 species of parasites, but this study did not include *P. fluviatilis.*

Only one parasite species - *Proteocephalus percae* was established in all examined host specimens, which clearly demonstrates the abundant presence of its intermediate host in the Batak reservoir and the lack or poor biodiversity of other macroinvertebrates that may serve as intermediate hosts of other parasitic species at the time of the present study.

CONCLUSIONS

1. As a result of this study it was found that the parasite fauna of the European perch (*Perca fluviatilis*) from the Batak Reservoir is represented by only one parasite species. Infestation with *Proteocephalus percae* (Linnaeus, 1758) was found in 100% of the examined fish specimens.

2. Proteocephalus percae is a widespread parasite of *Perca fluviatilis*, which is also its final host. Planktonic crustaceans of the order Copepoda (families Diaptomidae and Cydopidae) serve as intermediate hosts for Proteocephalus tapeworms in the Palearctic Region (Scholz, 1999).

3. The establishment of only one parasite specie – *Proteocephalus percae* in all examined fish specimens clearly indicates that its intermediate host is widespread in the Batak Reservoir. Perhaps even preferred food by *P. fluviatilis*. The absence of other parasitic species is most likely due to the poor variety of other invertebrates that eventually can serve as intermediate hosts or lack thereof at this certain moment.

4. Due to the fact that European perch is a predator, it is a suitable species for monitoring. This fish species is part of the monitoring systems of different European countries. In general, the structure and peculiarities of helminth communities reflect the peculiarities and state of the environment of their host. This study clearly shows that further research is needed for other host species as well as invertebrates from the Batak Reservoir to make a clear assessment of the ecological status of the freshwater ecosystem.

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