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Endohelminth fauna of barbel *Barbus barbus* (L. 1758) in the Serbian section of the Danube River, with dominance of acanthocephalan *Pomphorhynchus laeavis*

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Abstract
Infection of the barbel *Barbus barbus* (L. 1758) with endohelminths was observed in fish collected from eight localities in the Serbian part of the Danube River between September 2004 - 2009. Temporal variations in the number of parasites per fish sample were noted. A total of 194 fish specimens of different age, mostly males, were examined. The most prevalent parasitic species was the acanthocephalan *Pomphorhynchus laevis*, the dominant species of the intestinal component communities at all sampling sites which were recorded in 100% of the fish examined.

Introduction

The barbel *Barbus barbus* is a large, powerful member of the carp family (Cyprinidae). It is a benthopelagic long-lived fish, growing up to 120cm and 12kg (Simonovic, 2001). Feeding is on benthic organisms, including crustaceans, insect larvae (mayfly and midge larvae), molluscs, crayfish and swan mussels, as well as small fish and eggs of other fishes (Vukovic and Ivanovic, 1971; Losos et al., 1980; Maitland and Campbell, 1992). Spawning normally takes place in very shallow, fast-flowing waters, in riffles, from May to July, rarely until September when temperature reaches 15°C (Freyhof and Kottelat, 2008) after the fish have migrated upriver. The area of it's distribution extends in Western and Central Europe, from western France to the southwards to the drainage systems of the Rivers Rhone and Danube (Moravec et al., 1997). The barbel *B. barbus* was the subject of many ichthyological studies in Serbia (Djanic, 1979; Kiskaroly and Tafro, 1988; Cakic, 2002) contributed to the recognition of the ecology of this fish species and its populations in the Danube River Basin.

Most data on helminth communities in the barbel in Central Europe are derived from the Danube basin and the Elbe (Kritscher, 1955; Ergens and Lucky, 1959; Molnar, 1970; Moravec and Scholz, 1991; Gelnar et al., 1996, 1997). Certain helminths of barbel, mainly acanthocephalans, can occur in high intensities of infection. Acanthocephalans of

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the genus *Pomphorhynchus* Monticelli, 1905 are common parasites of fishes. The type and the most abundant species of the genus, *Pomphorhynchus laevis* (Zoega in Müller, 1776) occurs predominantly in cyprinid and also in salmonid fishes with the Palaearctic distribution (Dudiňák and Šnábel, 2001; Nedeva et al., 2003). This species has a high morphological variability (Brown, 1987) as well as host variability (Rašin, 1928; Petrochenko, 1956; Yamaguti, 1963; Hine and Kennedy, 1974; Kennedy et al., 1989; Moravec and Scholz, 1991).

In the present paper the results of a parasitological survey of the intestinal helminth fauna of *Barbus barbus* from the Serbian part of the Danube River are reported.

Materials and methods

A total of 194 large, medium-sized and small barbels were collected along the length of the Serbian part of the Danube River, from locality Stari Banovci (1.192 rkm) to downstream locality Prahovo (861 rkm) by bow nets in period September 2004 - 2009. Samples were taken from eight ecologically different sampling sites (Figure 1). Fish were transported to the laboratory and immediately examined for parasites. The total length, weight, sex and age were recorded for each fish specimen. The fish material was analyzed parasitological; particular attention was paid to helminth infections of the stomach and intestine. During the parasitological examination the intestines were cut open and examined under a stereomicroscope. Parasites found were bleached, stained, prepared and fixed for species identification and subsequent storage. Parasites were identified using identification keys (Bauer, 1987; Lom and Dykova, 1989; Moravec, 1994). Food items present in the gut were recorded.

Statistical analysis ANOVA (Tukey test) and one-way test were used to determine the significant differences between number of parasites per individual and sampled site/month, apropos Fulton's body conditional factor (factor of nourishment – CF) and normalised values of parasitic number per locality and month of sampling (statistical significant differences on level possibility of 5%), respectively.

Results

All fish specimens were infected by parasitic species *Pomphorhynchus laevis*. The number of parasites per individual was varied in range from 5 up to 463. The highest value was found in barbel specimen from Prahovo, in May 2005, with length 52 cm and 1.2 kg weight. Number of examined barbels and number of parasites per individual, as well as mean values of length and weight on each locality are presented (Table 1).

Barbel diet composed of members of the group Amphipoda (Crustacea) (*Dikerogammarus villosus, Dikerogammarus haemobaphes, Pontogammarus obessus, Obesogammarus obesus* and *Echinogammarus ischnus*), as well as from others macrozoobentho-groups (Mollusks, Ephemeroptea, Plecoptera, Chironomidae (Diptera) and Oligochaeta). These groups played the most important role in the diet.

According to results of ANOVA Tukey HSD test when variable was the number of parasites per sampling sites/months (Error: Between MS = 3946.5, df = 171.00) significant statistical

Table 1. Number of examined barbels and number of parasites per individual, as well as mean values of length and weight at each locality.

Locality	Number of examined barbels	Intensity of *P. laevis* infection	Mean value of length	Mean value of weight
STARI BANOVCI	10	7 - 205	31.81±3.13	353±113.1
ZEMUN	41	6 - 207	32.54±3.29	409±175.9
VISNJICA	25	9 - 124	41.21±8.30	720.68±352.7
GROCKA	29	6 - 193	36.21±6.57	517.43±223.4
ORESAC	57	5 - 285	31.28±6.55	382.12±257.2
SMEDEREVO	8	57 - 126	31.59±1.59	351.25±50.0
DJERDAP	5	14 - 58	23±3.60	122.40±77.3
PRAHOVO	18	13 - 463	38.89±14.44	721.58±588.5

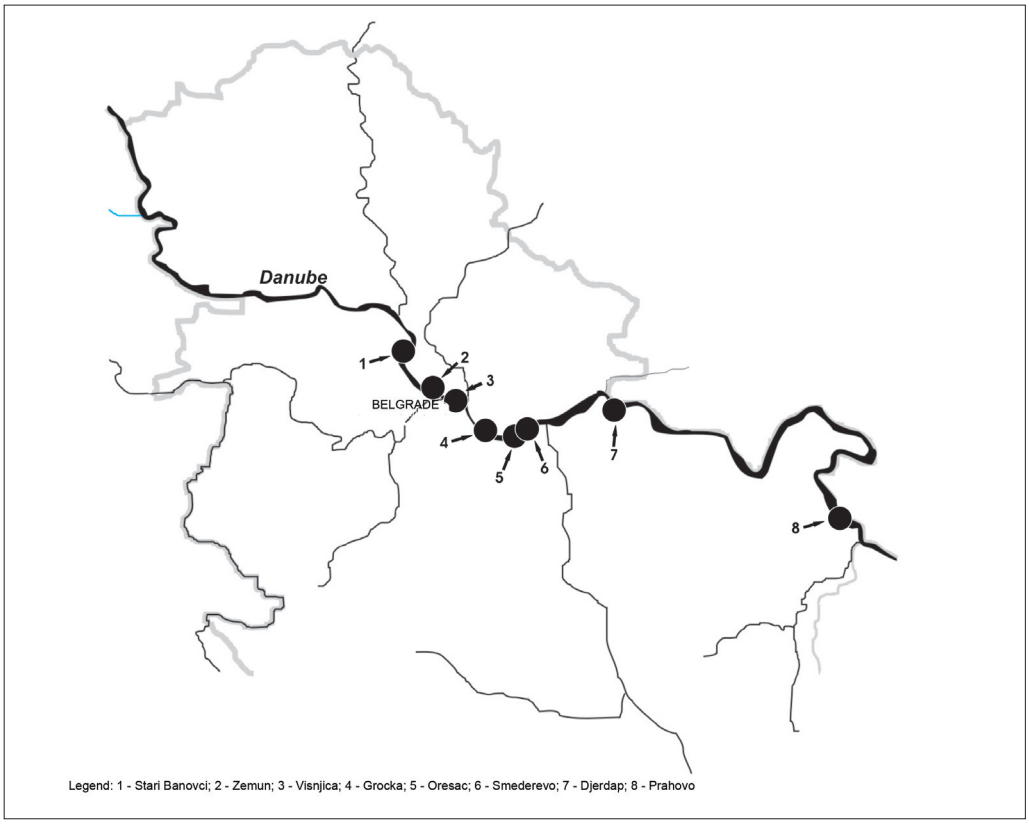

Figure 1. Fish sampling sites from the Danube River.

differences/dependence was observed from Prahovo, among barbels captured during September and May at this locality (Figure 2). The higher barbel infestation by *P.laevis* at Prahovo, in May and September is statistically significant compared with all other sites. Values range from 0.000071 (in comparation with Zemun locality, March) to 0.041824 (compare with Zemun, August).

Relation between normalized value of parasite number per individual and conditional factor (CF), shows negative corelation between them (Wilks lambda =.33950, F(50, 340)=4.8705, p=0.0000). Variables correspond to one another, higher CF follow lower number of acanthocephalans per individual, exept locality of Prahovo (Figure 2).

Discussion

Most existing data on the helminth fauna of barbel in Europe, is from the Danube River Basin. Rašin (1928) reported *P. leavis* from Obrava, Czech Republic; Kritscher (1955) recorded eight helminth species from small streams in Austria. Recently, data on the helminth parasites of *Barbus barbus* in the Morava River Basin has been provided by Gelnar et al. (1996,1997). In Hungary, Edelényi (1967), Molnar (1970) and Guti (1994) reported on barbel parasites from the Danube and Tisa Rivers. The most comprehensive paper dealing with the helminths of barbel in this region is that by Ergens et al. (1975), representing data from the Tisa River Basin in Slovakia, Hungary and the Soviet Union (the Ukraine). The helminth parasites of *B. barbus* were studied in the Balcan Peninsula: Roman (1955) reported on the parasites of barbel in the Danube River in Romania, whereas Margaritov (1959, 1966) and Kakacheva-Avramova (1962, 1977) on those from the Bulgarian part of the Danube River. Barbel parasites in the middle reaches of the Sava River have been studied (Rukavina and Delic, 1965; Cankovic et al., 1968). *Pomphorhynchus laevis* was found in 20 species of fishes from the River Danube, Serbian and Bulgarian section (Nedeva et al., 2003). Of all 156 examined fish specimens, 47 of them were found to be infected with this acanthocephalan, including nine individuals of *Barbus barbus* (Nedeva et al., 2003).

Beside acanthocephalan *P. laevis*, helminths found in barbel intestine were *Caryophyllaeus brachycollis, Acanthocephallus anguillae* and *Metagonimus yokogawai,* as well (Cakic, 2002; Cakic et al., 2007). The biology of the endoparasitic helminths of *B. barbus* is poorly known, especially as to their complex life cycles. This concerns both species which are specific to barbel (*Bathybothrium rectangulum* and *Rhabdochona hellichi*) and those with relatively wide host specificity (*Pseudocapillaria tomentosa, Pomphorhynchus laevis*) (Rašín, 1928; Moravec, 1983; Scholz and Moravec, 1996; Moravec and Scholz, 1991,1995).

No external or symptoms were apparent in fish infected with acanthocephalans. Furthermore, no alterations in structure, color and appearance of infected intestines were recorded. The acanthocephalan is not considered to be a zoonotic. The parasite does not appear to cause noticeable reductions or losses of fish specimens. However, previous studies have shown that the parasite can decrease condition factor as well as growth and delay development.

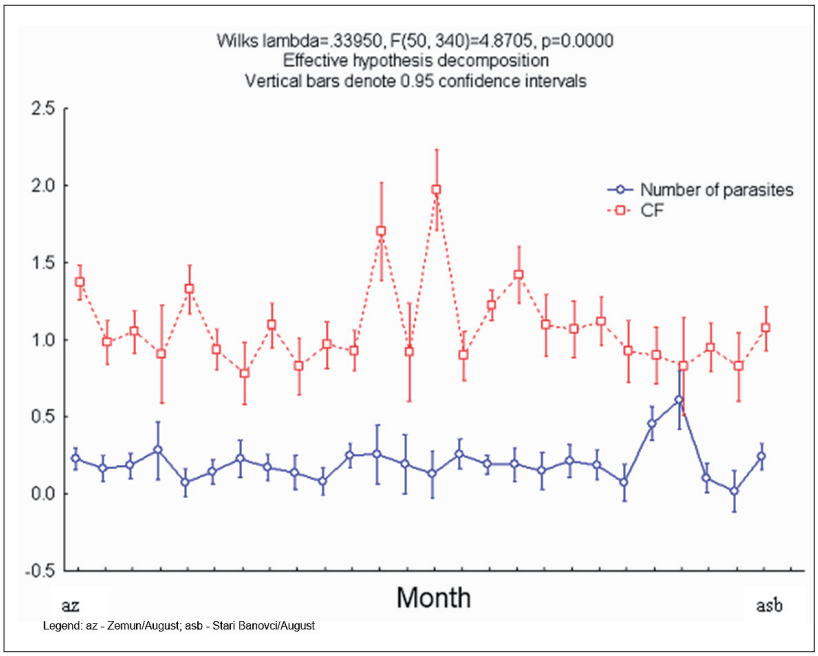

Figure 2. Relation between normalized value of parasite number per individual and conditional factor (CF).

The presence of *P. laevis* may have been influenced by the composition of available local macroinvertebrate community. Members from family Gammaridae (Amphipoda: Crustacea), as intermediate host, have been recorded in benthofauna along the course of the Serbian section of the Danube River, where the barbel has been captured (Paunovic et al., 2007, 2010). The species *Dikerogammarus villosus* is specific for the Serbian part of the Danube River (Paunovic et al., 2010) resume is that each barbel individual, from age when starts to feed on zoobenthos, is infected by parasitic species including *P. laevis*.

Statistical analyses show that barbel caught at Prahovo, in May and September, are different from others when compared to other localities and sampling period. Variability in the number of parasites per individual was also noted. The reason may be that individuals detected on this locality (the lake zone with overgrown macrophytes) are larger, with a large amount of Chironomidae, Ephemeroptera Plecoptera, mollusc shells and Gammaridae in their diet. As the number of acanthocephalans per individual is higher, the CH value is lower, and vice versa. Fulton's body condiitonal factor is the best predictor of parasite density (Neff and Cargnelli, 2004).

The current study has provided further information regarding the distribution of barbel parasites throughout its range. Future studies should consider expanding the number of sites examined to further understand the distribution of *P. laevis* and other parasites in barbel.

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