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BIODIVERSITY OF THE HELMINTH COMMUNITIES OF *Carassius gibelio* (Bloch, 1782) FROM MARITSA RIVER, BULGARIA

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Abstract

This study is the first to reveal the helminth fauna and helminth community's structure of Prussian carp (Carassius gibelio) from Maritsa River, Bulgaria. In 2022, ten Prussian carp specimens were collected from the Maritsa River and examined for parasites. 90% of the studied hosts harbour parasites. Two species of helminths were fixed: one from class Acanthocephala (Acanthocephalus anguillae Muller, 1780) and one from class Nematoda (Pseudocapillaria tomentosa Dujardin, 1843). The established nematode species is distinguished with high prevalence. Carassius gibelio is reported for the first time as a host for Pseudocapillaria tomentosa in Bulgaria. The river ecosystem of Maritsa is a new locality record for Pseudocapillaria tomentosa in Bulgaria.

Key words*: bioindication; Carassius gibelio; Maritsa River; helminth communities.*

INTRODUCTION

River Maritsa, whose length is 539 km, is the longest river on Balkan Peninsula. Its length on Bulgarian territory is 321.6 km, which makes it the fourth in length after the Danube, Iskar and Tundja. Maritsa springs from Rila Mountains at 2378 m altitude. The river has about one hundred significant tributaries, with the number of left and right tributaries almost equal. After crossing the border, the river passes through the territory of Greece and Turkey and flows into the Aegean Sea. The river's upper course covers the part from the source to the town of Belovo. The river's middle course covers the section through the Upper Thracian lowland from Belovo to the Bulgarian border. The lower course of Maritsa covers the section from the Bulgarian border to the mouth of the river. Almost the entire middle course of the river has been declared a protected area BG 0000578 "River Maritsa" according to Directive 92/43 and protected area BG 0002081 "Maritsa - Parvomaj" according to Directive 79/409.

The biodiversity of fish helminth communities from the Maritsa River was subject to investigation (Margaritov, 1965; Kirin, 2000a; Kirin, 2000b; Kirin, 2006; Kirin, 2013; Kirin, 2014; Chunchukova et al., 2019a; 2019b; Kuzmanova et al., 2019), endohelminth species biodiversity of *Carassius gibelio* is not explicitly examined. This study is the first that reveals the Prussian carp's endohelminth species biodiversity of from the river ecosystem of Maritsa, Bulgaria.

MATERIALS AND METHODS

In the summer of 2022, ten Prussian carp were caught from the Maritsa River in Plovdiv and examined for parasites. Plovdiv is located in the western part of the Upper Thracian lowland in Bulgaria and on both banks of the Maritsa River.

The width of the river section in this territory varies from 100 to 600 m, and the river's slope in the city area is minimal. On the part of Plovdiv, the rivers Parvenetska and Pyaschnik flow into Maritsa.

The fish was caught with a fishing line. The common and taxonomic name of fish is used in accordance with Fröse & Pauly (2022).

An incomplete parasitological examination was carried out immediately after their catch for helminths. Acanthocephalan specimens are examined in ethanol-glycerin as temporary slides and identified (Petrochenko, 1956; Ergens & Lom, 1970; Bykhovskaya-Pavlovskaya, 1985). The specimens from class Nematoda are studied in glycerine as temporary

slides and identified (Moravec, 2013). The helminths were determined following the keys of Bauer (1987).
The ecological terms mean intensity (MI), mean abundance (MA) and prevalence (P %) are used and calculated based on Bush et al. (1997). Based on the prevalence as suggested by Kennedy (1993), the parasites are grouped as core (>20), component (< 20) and accidental (< 10).

RESULTS AND DISCUSSIONS

During 2022, ten Prussian carp were caught from the river ecosystem of Maritsa and examined for parasites. *Carassius gibelio* (Pisces: Cyprinidae) is untypical and introduced species for aquatic ecosystems in Bulgaria (Stefanov, 2007). The Prussian carp is estimated as LC = Least Concern species (IUCN). *Carassius gibelio is* a freshwater, brackish, benthopelagic, potamodromous, omnivorous fish species (Fröse & Pauly, 2022). This cyprinid is distinguished by its rapid growth and its unpretentiousness to environmental conditions (Karapetkova & Zhivkov, 2010). The Prussian carp is tolerant of pollution and low oxygen levels (Kottelat & Freyhof, 2007). *Carassius gibelio* is widely distributed in Topolnitsa, Luda Yana, Stryama and Chepinska (Kolev, 2020).
From the study, ten specimens of Prussian carp from the Maritsa River 90.0% (9 fish) harbour parasites (Table 1). Thirty-six specimens (p) were established from two parasite taxa–one from class Acanthocephala (*Acanthocephalus anguillae* Müller, 1780) and one from class Nematoda (*Pseudocapillaria tomentosa* (Dujardin, 1843)). Both established parasite species occurred as adults.

Table 1. Helminth species of *Carassius gibelio* (N - number of studied fish, n - number of infected fish)

Helminth species	N = 10					
	n	p	P%	MI±SD	MA±SD	Range
Acanthocephalus anguillae (Muller, 1780)	1	2	10.00	2.0 ± 0.0	0.2 ± 0.6	0-2
Pseudocapillaria tomentosa (Dujardin, 1843)	9	34	90.00	3.78 ± 2.48	3.4 ± 2.62	1-8

The roundworm *Pseudocapillaria tomentosa* is distinguished with a high prevalence P% = 90.0 which determined it a core parasite, while *A. anguillae* (P% = 10.0) is an accidental species for the Prussian carp (Table 1).
The development of *A. anguillae* takes place with the participation of an intermediate host, *Asellus aquatics* (Linnaeus, 1758) (Kakacheva-Avramova, 1983). This crustacean indicates α-mesosaprobity (Johnson et al., 1993).
Even though the definitive hosts for *A. anguillae* are cyprinid, salmonid, percid, etc. fish (Kakacheva-Avramova, 1983), the paratenic host *Lutra lutra* was also reported for Bulgaria (Dimitrova et al., 2008).
Only two cyprinid hosts have been reported from river Maritsa for *Acanthocephalus anguillae,* with an enormous time gap between the studied hosts (Table 2).
In Europe, definitive hosts for *P. tomentosa* are fish from the family Cyprinidae (Moravec, 2013). The life cycle of *P. tomentosa* is incompletely established, but under natural conditions, oligochaetes play significant importance as a source of *P. tomentosa* infection for fish (Moravec, 2013).

Table 2. Fish hosts of *A. anguillae* reported from the Maritsa River

Host	Year
Alburnus alburnus	1965*[1]
	1965*[2]
Squalius cephalus	2000* [3]
	2000*[4]

[1]Kakacheva-Avramova
[2]Margaritov
[3]Kirin (a)
[4]Kirin (b)

Until now, only three fish species (see Table 3) are reported from Bulgarian rivers as hosts of *Pseudocapillaria tomentosa,* all cyprinid fish. The records are from Struma, Iskar and Danube (Nachev & Sures, 2009; Davidova et al., 2011; Zaharieva & Kirin, 2020). River Maritsa is a new locality, and *C. gibelio* is a new host record for *P. tomentosa* in Bulgaria.

Table 3. List of hosts of *Pseudocapillaria tomentosa* in Bulgaria

Host	Locality	Authority
Barbus barbus	Danube River	Nachev & Sures (2009)
Rhodeus amarus	Struma River Iskar River	Davidova et al. (2011)
Chondrostoma nasus	Danube River	Zaharieva & Kirin (2020)

Of the examined fish specimens, 80% were infected with only one parasite, the taxa - *Pseudocapillaria tomentosa* (Table 4). With two helminth species infected, only one fish host (10.00%). The average species richness in infracommunity of *C. gibelio* is 1.00 ± 0.45 species.

The most significant number of helminth specimens per host was eight found in two fish hosts. The average abundance in the infracommunities of Prussian carp is 3.6 ± 2.5. The parasite communities of *C. gibelio* from the Maritsa River showed a low value of Brillouin diversity index HB = 0.23 (Table 4).

Table 4. Infracommunities of *Carassius gibelio*

Carassius gibelio	Number of endohelminth species				
	0	1	2	Mean ± SD	Range
	1	8	1	1.0 0.45	0-2
	Number of endohelminth specimens				
	Total number	Mean ± SD	Range	Brillouin's index HB	
Carassius gibelio	36	3.6 ± 1.5	0-8	0.23	

Fish parasite fauna from the Maritsa River was also studied in previous cases (Margaritov, 1965; Kirin, 2000a; Kirin, 2000b; Kirin, 2006; Kirin, 2013; Kirin, 2014; Chunchukova et al., 2019a; 2019b; Kuzmanova et al., 2019), but Prussian carp's endohelminth species biodiversity was not explicitly examined. This study first reveals the parasite fauna of *Carassius gibelio* from River Maritsa. Twenty-six parasite species of Prussian carp in Bulgaria have been identified, although it is not a frequently studied species (Table 5).

Table 5. Overview of the established parasites of *Carassius gibelio* in Bulgaria and their locality

Authority / Helminth species	Margaritov (1959)	Margaritov (1964)	Margaritov (1966)	Kakacheva-Avramova (1977)	Grupcheva & Nedeva (1999)	Shukerova (2005)	Atanasov (2012)	Kirin & Chunchukova (2021)	Chunchukova & Kirin (2021)	Kirin & Chunchukova (2022)	This study
Paradilepis scolecina (Rudolphi, 1819)					√						
Dactylogyrus anchoratus (Dujardin, 1845)	√	√		√	√						
Dactylogyrus extensus Mueller & Van Cleave, 1932		√									
Dactylogyrus formosus Kulwiec, 1927		√									
Dactylogyrus intermedius Wegener, 1909					√						
Dactylogyrus minutus Kulwiec, 1927		√									
Dactylogyrus vastator Nybelin, 1924		√									
Dactylogyrus vistulae Prost, 1957					√						
Dactylogyrus wegeneri Kulwiec, 1927		√									
Diplostomum helveticum (Dubois, 1929)					√						

Diplostomum pseudospathaceum Niewiadomska, 1984							√				
Diplostomum rutili Razmashkin, 1969						√					
Ancyrocephalus sp. Creplin, 1839					√						
Gyrodactylus medius Kathariner, 1893		√									
Gyrodactylus shulmani Ling, 1962					√						
Gyrodactylus sprostonae Ling, 1962					√						
Urocleidus similis (Mueller, 1936)					√						
Paradiplozoon homoion (Bychowsky & Nagibina, 1959)					√						
Posthodiplostomum cuticola (Nordmann, 1832)						√					
Nicolla skrjabini (Iwanitzky, 1928) Dollfus, 1960										√	
Raphidascaris acus (Bloch, 1799), larvae						√					
Contracaecum microcephalum (Rudolphi,1809), larvae						√					
Contracaecum sp. (Rudolphi,1809), larvae										√	
Pseudocapillaria tomentosa (Dujardin, 1843)											√
Ligula intestinalis (Linnaeus, 1758), larvae								√			
Acanthocephalus anguillae (Müller, 1780)							√		√		√
Pomphorhynchus laevis (Zoega in Muller, 1776)			√	√	√		√	√		√	
Locality	Chelopechene	Batak Reservoir	Danube	Danube	Zrebchevo reservoir	Lake Srebarna	Danube	Panicheri reservoir	Tundja	Tundja	Maritsa

CONCLUSIONS

This study is the first that reveals the parasite fauna of Prussian carp from the river ecosystem of Maritsa. Two parasite species were identified: *Acanthocephalus anguillae* and *Pseudocapillaria tomentosa*. The established nematode species *P. tomentosa* is distinguished with high prevalence. *Carassius gibelio* from the ecosystem of Maritsa represents a new host record in Bulgaria. River Maritsa is a new locality for *P. tomentosa. Acanthocephalus anguillae* is reported for the helminth communities of *C. gibelio* from the Maritsa River for the first time.

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