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STRUCTURE OF THE POPULATIONOF *ACANTHOCEPHALUS ANGUILLAE* IN *CARASSIUS GIBELIO* FROM TUNDJA RIVER, BULGARIA

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Abstract

During the ecological study of 19 specimens of Prussian carp (Carassius gibelio, Bloch, 1782) from Tundja River, by applying standard techniques for parasites, an infestation was found with the acanthocephalan species Acanthocephalus anguillae (Müller, 1780). Helminth parasites were recorded in 5 Prussian carp specimens (26.32%). The established helminth species is autogenic species, matured in fish. In the component community of Carassius gibelio from Tundja River A. anguillae is core species. This study is the first that presents the Prussian carp's endohelminth species biodiversity from Tundja River, Bulgaria. The established in this study parasite species is discussed and compared with previous researches of parasite communities of C. gibelio from Bulgaria.This is the first report of Acanthocephalus anguillae for the helminth communities of Prussian carp for river related to Aegian Basin in Bulgaria.

Key words*: Acanthocephalus anguillae, Carassius gibelio, helminths, Tundja River.*

INTRODUCTION

The Tundja River is the third-longest river in Bulgaria (349.5 km on Bulgarian territory) after the Danube and Iskar. The Tundja River springs from the central parts of Stara Planina north of Kalofer. After Kalofer passes from west to east between the mountain ranges of Stara Planina to the north and Sredna Gora to the south. After city of Sliven, the river flows to the southeast and below city of Yambol - to the south direction and leaves Bulgaria in the Edirne direction, where it merges with Maritsa River (Evros). The river is related to Aegean Basin and is included in the National monitoring program (Water Body Type BG3TU570R066) (Regulation 1/2011).

The Tundja River is impacted of domestic wastewater and, 'poor' to 'bad' nutrient quality prevails (Skoulikidis et al., 2009). Species composition of the ichthyofauna of Lower stream of Tundzha River is presented by 19 fish species belonging to 8 families (Kolev, 2014). Fish parasite communities and biodiversity from the Tundja River were studied not often (Kakacheva-Avramova, 1972; Kirin et al., 2013; Chunchukova & Kirin, 2020). This study is the first that presents the results of examinations of the Prussian carp's (*Carassius gibelio*, Bloch, 1782) endohelminth species biodiversity from Tundja River, Bulgaria.

MATERIALS AND METHODS

In the summer of 2019, fish and fish parasites are collected and examined from Tundja River (city of Yambol). The city of Yambol (42°29′N 26°30′E) is located in south-eastern Bulgaria and is situated on both banks of the Tundja River.

Almost the entire Lower Tundja River from the city of Yambol till before leaving Bulgarian boundaries is about to be pronouncing as Protected Zone (NATURA 2000 zones: Reka Tundzha 2 BG0000195).

A total of 19 specimens of Prussian carp from Tundja River are collected and examined in 2019. Fish are caught by angling. The scientific and common name of fish host is used according to the FishBase database (Froese & Pauly, 2021). The fish are examined immediately after their capture for gastrointestinal helmiths (an incomplete parasitological study), using standard techniques. The samples are counted and identified using keys of Bauer et al. (1981), Bauer (1987) and Bykhovskaya-Pavlovskaya (1985). Acanthocephalan specimens are examined as temporary slides in

ethanol-glycerin and identified (Petrochenko, 1956; Ergens & Lom, 1970; Bykhovskaya-Pavlovskaya, 1985).

The ecological terms prevalence (P%), mean intensity (MI) and mean abundance (MA) are used and calculated, based on Bush et al. (1997). The dominant structure of the component helminth communities was determined according to the criteria proposed by Kennedy (1993) based on the prevalence (P%) as: accidental (P% < 10), component (P% < 20) and core (P% >20) species.

RESULTS AND DISCUSSIONS

A total of 19 specimens Prussian carp (*Carassius gibelio* from Tundja River were collected and examined for parasites. Helminth parasites were recorded in 5 Prussian carp specimens (26.32%) from Tundja River. Only one parasite species was identified - the acanthocephalan species *Acanthocephalus anguillae* (Müller, 1780). The mean intensity of *A.anguillae* is 1.6 ± 0.8 and the mean abundance is 0.42 ± 0.82 (Table 1). The only established helminth species occurred as adult. *A. anguillae* is autogenic species matured in fish.

Carassius gibelio is classified as least concern species (LC=Least Concern; IUCN Red List Status). The Prussian carp is not included in the Red Data Book of the Republic of Bulgaria (Golemanski, 2011). *Carassius gibelio* is not typical for Bulgarian waters but is introduced (Stefanov, 2007). Prussian carp is a freshwater, benthopelagic, brackish, potamodromous fish species (Froese & Pauly, 2021). In Bulgaria, this species is widely distributed in most marshes, plain and sub mountain lakes, dams and rivers (Vassilev & Pehlivanov, 2005). Prussian carp is omnivorous and feeds on larvae of plankton, benthic invertebrates, plant material and detritus (Froese & Pauly, 2021). *Carassius gibelio* can tolerate low oxygen concentrations and pollution (Kottelat & Freyhof, 2007).

The life cycle of *A. anguillae* is accomplished with the precipitation of the intermediate crustacean host - *Asellus aquaticus* (Linnaeus, 1758) (Petrochenko, 1956; Kakacheva-Avramova, 1983; Bauer, 1987). *A. aquaticus* is a bioindicator for α-mesosaprobity (Johnson et al., 1993). Fish are definitive hosts for this acanthocephalan species, but there is also data from Bulgaria for paratenic host *Lutra lutra* (Dimitrova et al., 2008).

A. anguillae was reported as parasite of other cyprinids from Tundja River (Table 2).

Table 1. Ecological indices of the helminth parasite of *C. gibelio* from Tundja river
(N - number of examined fish specimens, n - number of infected hosts, p - number of parasites, P% - prevalence , MA - mean abundance, MI - mean intensity)

Helminth species	N	n	p	P%	MA ± SD	MI ± SD	Range
Acanthocephalus anguillae	19	5	8	26.32	0.42 ± 0.82	1.6 ± 0.8	1-3

Table 2. Fish species reported as hosts of *Acanthocephalus anguillae* from Tundja River in Bulgaria

Host	**References**
Alburnus alburnus	Kirin et al., 2013
Squalius cephalus	Chunchukova & Kirin, 2020
Chondrostoma vardarense	Chunchukova & Kirin, 2020

For the same cyprinid hosts from River Tundja was reported also the acanthocephalan species *Pomphorhynchus laevis* (Müller, 1776), but from earlier study (Kakacheva-Avramova, 1972).

The established in this study *Acanthocephalus anguillae* is an intestinal parasite of many freshwater fish in Bulgaria mainly from Cyprinidae family, and also there are records from families Salmonidae and Percidae (see Table 3). The records are from different rivers in Bulgaria, with the exception of the data for Srebarna Lake (Shukerova et al., 2010; Shukerova & Kirin, 2019), which is probably due to the connection of the Lake with the Danube River.

Table 3. Overview of fish species registered as hosts of *Acanthocephalus anguillae* in Bulgaria and their locality

Fish host	Locality	References
Cyprinidae Family		
Alburnus alburnus	Maritsa River	Kakacheva-Avramova (1965)
		Margaritov (1965)
	Tundja River	Chunchukova & Kirin (2020)
	Arda River	Kirin (2003)
Abramis brama	Danube River	Atanasov (2012)
		Chunchukova et al.(2016)
Barbus barbus	Danube River	Nachev & Sures (2009)
		Atanasov (2012)
		Chunchukova & Kirin (2018)
Barbus cyclolepis	Chepinska River	Margaritov (1965)
	Luda Yana River	Kirin (2002a)
	Arda River	Kirin (2003)
Blicca bjoerkna	Danube River	Margaritov (1966)
		Kakacheva-Avramova (1977)
Carassius gibelio	Danube River	Atanasov (2012)
Chondrostoma vardarense	Tundja River	Chunchukova & Kirin (2020)
Rutilus rutilus	Chepinska River, Bistrica River	Margaritov (1965)
	Srebarna Lake	Shukerova & Kirin (2019)
Squalius cephalus	Barzia River, Chuprenska River	Kakacheva-Avramova (1969)
	Stryama River	Kakacheva-Avramova (1973)
		Kirin et al. (2005)
	Palakaria River	Kakacheva-Avramova & Menkova (1978)
	Chepinska River	Margaritov (1965)
	Maritsa River	Kirin (2000a), Kirin (2000b)
	Chepelarska River	Kirin(2002b)
Leuciscus idus	Danube River	Margaritov (1959)
		Margaritov (1966)
		Kakacheva-Avramova (1977)
Squalius orpheus	Tundja River	Kirin et al. (2013)
Family Percidae		
Perca fluviatilis	Srebarna Lake	Shukerova et al. (2010)
Family Salmonidae		
Salmo trutta	Barzia River, Chuprenska River	Kakacheva-Avramova (1969)

The ichthyofauna of the Lower stream of River Tundja is presented by 19 fish species belonging to 8 families (Kolev, 2014). Fourteen of them were subject to ecogoparasitological investigation in previous studies (Kakacheva-Avramova, 1972; Kirin et al., 2013; Chunchukova & Kirin, 2020). For ten of the fish species was reported at least one acanthocephalan species in these studies. This is the first study of helminth fauna of *Carassius gibelio* from River Tundja. Generally the helminth fauna of Prussian carp was not very often studied in Bulgaria.

For Bulgaria were reported twenty three parasite species - *Paradilepis scolecina, Dactylogyrus anchoratus*, *D. extensus*, *D. formosus*, *D. intermedius, D. minutus, D. vastator, D. vistulae, D. wegeneri, Diplostomum helveticum, D. pseudospathaceum, D. rutili, Ancyrocephalus* sp., *Gyrodactylus medius, G. shulmani, G. sprostonae, Urocleidus similis, Paradiplozoon homoion, Posthodiplostomum cuticola*, *Raphidascaris acus* larvae, *Contracaecum microcephalum* larvae, *Acanthocephalus anguillae* and *Pomphorhynchus laevis* as helminth parasites of *Carassius gibelio* (Table. 4).

Table 4. Overview of parasite species of *Carassius gibelio* registered in Bulgaria

Authority / Helminth species	Margaritov (1959)	Margaritov (1964)	Margaritov (1966)	Kakacheva-Avramova (1977)	Grupcheva & Nedeva (1999)	Shukerova (2005)	Atanasov (2012)	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							•	
Diplostomumrutili 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)						•		
Raphidascaris acus (Bloch, 1799), larvae						•		
Contracaecum microcephalum (Rudolphi,1809), larvae						•		
Acanthocephalusanguillae (Müller, 1780)							•	•
Pomphorhynchus laevis (Zoega in Muller, 1776)			•	•	•		•	

CONCLUSIONS

This is the first study of helminth fauna of *Carassius gibelio* from River Tundja. The determined helminth species *A. anguillae* is a core species for the helminth communities of Prussian carp's from the studied ecosystems. This is the first report of *Acanthocephalus anguillae* for the helminth communities of *C. gibelio* for river related to Aegian Basin in Bulgaria.

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REFERENCES

Atanasov, G. (2012). Fauna, morphology and biology on the endohelminths of fish from Bulgarian part of the Danube River. PhD these, BG: Sofia (In Bulgarian).

Bauer, O. N., Musselius, V. A. & Strelkov, Yu. A. (1981). *Diseases of pond fish*. Moscow, RU: Legkaya Pishchevaya Promishlenost' Publishers (In Russian).

Bauer, O.N. (1987). *Key to the parasites of freshwater fishes in the fauna of the U.S.S.R*. Leningrad, RU: Academy of Sciences, USSR, Nauka.

Bush, A., Lafferty, K., Lotz, J. &Shostak A. (1997). Parasitology meets ecology on its own terms. *Journal of Parasitology, 83*, 575-583.

Bykhovskaya-Pavlovskaya, I. (1985). *Parasites of fish. Manual on study*, Leningrad, RU: Nauka, (In Russian).

Chunchukova, M. & Kirin, D. (2020). Helminth fauna of some cyprinid fish species from lower stream of River Tundzha, Bulgaria. *International May Conference on Strategic Management* – IMCSM20, XVI(1), 465-473.

Chunchukova, M., Shukerova, S., & Kirin, D. (2016). Research of the impact of the river Danube on the Srebarna biosphere reserveby the model ecosystem *Abramis brama* - macroinvertebrates – sediments. *Agricultural Sciences*, VIII, *19*, 151-158.

Chunchukova, M. & Kirin, D. (2018). New data on endohelminth communities of barbel *Barbus barbus* from the Bulgarian part of the River Danube. *Helminthologia*, *55*, 222-229.

Dimitrova, Z. M., Tzvetkov, Y. & Todev, I. (2008). Occurrence of acanthocephalans in the Eurasian otter *Lutra lutra* (L.) (Carnivora, Mustelidae) in Bulgaria, with a survey of acanthocephalans recorded from this host species. *Helminthologia*, *45*(1), 41-47.

Ergens, R. & Lom, J. (1970). *Causative agents of fish diseases.* Prague, CZ: Academia, 384 (In Czech).

Froese, R. & D. Pauly (Eds.), 2021.Fish Base. World Wide Web electronic publication, www.fishbase.org (28 February 2021, date last accessed).

Golemanski, V. (Ed-in-Chief) (2011). *Red Data Book ofthe Republic of Bulgaria*. Sofia, BG: Jointedited of theBulg.Acad of Sci. and Ministry of Environment andWaters, Vol. 2 - Animalia (In Bulgarian).

IUCN Red List Status, (n.d.)www.iucnredlist.org

Johnson, R. K, Wiederholm, T. & Rosenberg, D. M. (1993). Freshwater biomonitoring using individual organisms, population, and species assemblages of benthic macroinvertebrates. In: Rosenberg, D.M.&Resh, V.H. (eds) (1993). *Freshwater Biomonitoring and Benthic Macroinvertebrates*. Chapman and Hall, London.

Kakacheva-Avramova D. & I. Menkova (1978). Examination of helminths in fish from reservoir Iskar. II. Helminths of fish from river Palakariya. *Helminthologia*, *5*, 39–46 (In Bulgarian).

Kakacheva-Avramova, D. (1965). Helminthological study of fishes from some water basins in Trakia. *Fauna ofTrakia*, *2*, 83-120 (In Bulgarian).

Kakacheva-Avramova, D. (1969). Helminths by fish from rivers of western Stara planina mountain. II. Trematoda, Cestoda, Acanthocephala, Nematoda. *Notifications of the CHL*, XIII, 61-74 (In Bulgarian).

Kakacheva-Avramova, D. (1972). Contribution to the helminth fauna of fish from river Tundzha. *Notificatios of CLF*, BAS, *XV*, 89-105 (In Bulgarian).

Kakacheva-Avramova, D. (1973). Helminth fauna of fish from rivers of Central and Eastern Balkan mountain. *Notificatios of CHL*, BAS, *XVI*, 87-109 (In Bulgarian).

Kakacheva-Avramova, D. (1977). Studies on helminths of fishes in the Bulgarian section of the Danube River. *Helminthologia*, 3, 20-45 (In Bulgarian)

Kakacheva-Avramova, D. (1983). *Helminths of freshwater fishes in Bulgaria*. Sofia, BG: Bulgarian Academy of Sciences (In Bulgarian).

Kennedy, C. (1993). The dynamics of intestinal helminth communities in eels *Anguilla anguilla* in a small stream: long-term changes in richness and structure. *Parasitology*, *107*, 71-78.

Kirin, D. (2002a). Biodiversity and ecological characteristics of the helminth communities in *Barbus tauricus cyclolepis* from Luda Yana river, Bulgaria. *Comptesrendusdel'Academiebulgaredes Science*, *55*(5), 97-102.

Kirin, D. (2003). Biodiversity and ecologycal evaluation of the helminths communities of *Barbus cyclolepis* and *Alburnus alburnus* from Arda river, Bulgaria. *Experimental pathology and helminthology*, *6*(11), 44-50

Kirin, D. A. (2000a). Ecologofaunistical study of the helminthological communities of *Leuciscus cephalus* L. from Maritsa River. *Nauchni Trudove na Sayuza na Uchenite v Bulgaria, Plovdiv, 1*, 405-408 (In Bulgarian).

Kirin, D. A. (2000b). Biodiversity and ecological assessment of the status of freshwater ecosystems from the Maritsa River. *Nauchni Trudove na Sayuza na Uchenite v Bulgaria, Smolyan, 1*, 82 – 85 (In Bulgarian).

Kirin, D. A. (2002b). Ecological study of the intestinal helminth communities of *Leucis cuscephalus* (L., 1758) and appraisal of the conditions of the studied freshwater ecosystems from the Chepelarska River, Bulgaria. *Acta Zoolologica Bulgarica, 54*, 73-85.

Kirin, D. A., Koev, K., Ivanova, D. &Kuzmanov N. (2005). Biodiversity and ecological appraisal for conditions of the Stryama River, Bulgaria. *Journal of Environmental Protection and Ecology, 6*, 69-82.

Kirin, D., Boyanov, B.& Ilieva, N. (2013). Biodiversity and heavy metal pollutions in freshwater ecosystems in border areas from Tunja river. Environmental issues in materials science and engineering. *Materials Protection*, *2*(54), 153-160.

Kolev, V. (2014). Research on the ihcthiofauna in the Lower Tundzha River in relation to alternative forms of tourism in the region of Yambol and Elhovo.*Management and sustainable development 6* (49), 94-102. (In Bulgarian, English summary).

Kottelat, M. & J. Freyhof, 2007. *Handbook of European freshwater fishes*. Publications Kottelat, Cornol and Freyhof, Berlin.

Margaritov, N., 1959. *Parasites of some freshwater fishes*. Varna, BG: Publishing House NIRRP. (In Bulgarian).

Margaritov, N., 1966. Helminths of the digestive tract and the abdominal cavity of fishes of the Bulgarian section of Danube River. *Bulletin de L'institut de Zoologie et Musée*, 20, 157–173 (In Bulgarian).Margaritov, N.M. (1965). Intestinal helminths of fishes of the middle reaches of the R. Maritsa and tributaries. *Godshnik na Softyskia universitet Biologicheski fakultet*, *58*. 129-150 (In Bulgarian)Nachev, M. & Sures, B. (2009). The endohelminth fauna of barbel (*Barbusbarbus*) correlates with water quality of the Danube River in Bulgaria. *Parasitology*, *136*, 545-552.

Petrochenko, V.I. (1956). *Acanthocephala of Domestic and Wild Animals,* Moskow, RU: NAS of SSSR (In Russian).

Shukerova S., 2005. Helminth fauna of the Prussian carp, *Carassius gibelio* (Bloch, 1782), from the Srebarna biosphere reserve. *Trakia journal of Sciences, 3*, 33-40.

Shukerova, S. A., & Kirin, D. A. (2019). Helminth Communities of Roach *Rutilus rutilus* (L., 1758) (Cypriniformes: Cyprinidae) from Srebarna Biosphere Reserve, Bulgaria. *Acta Zoologica Bulgarica, 71*(2), 285-292.

Shukerova, S., Kirin D. & Hanzelova V. (2010). Endohelminth communities of the perch, *Percafluviatilis* (Perciformes, Percidae) from Srebarna Biosphere Reserve, Bulgaria. *Helminthologia*, *42*, 2, 99-104.

Skoulikidis, N., Economou A. N., Gritzalis K. &Zogaris, S. (2009). Rivers of the Balkans. In Tockner, K., Uehlinger U. & Robinson C. C. T. (eds), *Rivers of Europe* (421-466). Amsterdam: Academic Press, Elsevier.

Stefanov, T. (2007). Fauna and distribution of fishes in Bulgaria. In: Fet V. & Popov A. (Eds.): *Biogeography and Ecology of Bulgaria*. Dordrecht: Springer, pp. 109-139.

Vassilev, M. & Pehlivanov L. (2005). Checklist of Bulgarian freshwater fishes. *Acta Zoologica Bulgarica, 57*(2), 161-190.