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PARASITES AND PARASITE COMMUNITIES OF THE COMMON NASE (*CHONDROSTOMA NASUS* (LINNAEUS, 1758)) FROM THE DANUBE RIVER

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Abstract

In 2019, studies on the parasites and parasite communities of Chondrostoma nasus (Linnaeus, 1758) from the Danube River, Bulgaria (Koshava and Kudelin villages, Vidin region) were conducted. After ecoparasitological studies of a total of 155 specimens of C. nasus from the two biotopes, eight species of parasites were found: two species of the class Trematoda (Allocreadium isoporum (Looss, 1894), Sphaerostomum bramae (Müller, 1776)), one species of the class Cestoda (Bothriocephalus acheilognathi (Yamaguti, 1934, immature specimens)), one species from the class Acanthocephala (Pomphorhynchus laevis (Müller, 1776)) and four species from the class Nematoda (Raphidascaris acus (Bloch, 1779), larvae; Contracaecum sp., larvae; Hysterothylacium sp., larvae; Pseudocapillaria tomentosa (Dujardin, 1843)). The majority of parasite species (seven species) were detected during the spring from biotope Kudelin. The dominant parasite species in all three seasons was the nematode Contracaecum sp. C. nasus was reported as a new host for A. isoporum, S. bramae, B. acheilognathi, R. acus, Contracaecum sp., Hysterothylacium sp., P. tomentosa from the Bulgarian section of the Danube River. New data on the structure of parasite communities of the river freshwater ecosystem were presented.

Key words*: Bulgaria, Chondrostoma nasus, Danube River, helminths, helminth communities.*

INTRODUCTION

The Danube River is among the longest rivers in Europe, it takes second place (2,857 km long). The river passes through ten European countries, including Bulgaria (Juhásová et al., 2019). Flowing across much of the continent, the Danube River connects the countries from Western, Central and Eastern Europe (Hock and Kovdcs, 1987). Along its course (from the Black Forest to the Black Sea), the river provides a wide variety of habitats.

The river is home and an important place for the conservation of many plant and animal species. (http://www.danubeparks.org).

In comparison to all European rivers, the Danube River is characterized by the most significant diversity of fish species, with more than 100 reported species. Fish species from six families - Cyprinidae, Percidae, Gobiidae, Cobitidae, Salmonidae and Acipenseridae, are dominant in the ichthyofauna of the Danube River (Keckeis & Schiemer, 2002; Kováč, 2015). Various authors have studied the ichthyofauna of the Danube River (Pehlivanov, 2005; Polačik et al., 2008; Lenhardt et al., 2010; Sandu (Calin) and Oprea, 2013; Bănăduc et al., 2014; Zorić et al., 2014; Kováč, 2015, etc.). Not only individual fish species but also their parasites are an object of study. The role of parasites in different ecosystems is significant. They influence on species diversity; respond to changes in the environment; provide information on food chains and the state of the ecosystem. The presence of more parasite species is a sign of the state of the whole ecosystem (Sures et al., 2017).

Different authors investigate the parasites and parasite communities of freshwater fish species from the Danube River (Cojocaru, 2003; Cakić et al., 2008; Cojocaru, 2009; Nachev and Sures, 2009; Đikanović et al., 2013; Kirin et al., 2013; Kvach et al., 2013; Kirin et al., 2014; Đikanović et al., 2015; Chunchukova et al., 2016; Kvach et al., 2016; Kvach et al., 2017; Chunchukova and Kirin, 2018; Chunchukova et al., 2018; Đikanović et al., 2018; Juhásová et al., 2019; Radačovská et al., 2019), but few authors provide information on parasites of the common nase (*Chondrostoma nasus* (Linnaeus, 1758))

from the Danube River (Cojocaru, 2007; 2009; 2010; Đikanovic et al., 2011; Kirin et al., 2013). New data on the parasites and parasite communities of common nase (*Chondrostoma nasus* (Linnaeus, 1758)) from the Bulgarian territory of the Danube River in its upper section were presented.

MATERIALS AND METHODS

During the spring, summer and autumn of 2019, fish and fish parasites were collected and examined from the Danube River (Koshava village and Kudelin village, Vidin region, designated as Koshava biotope and Kudelin biotope) (Figure 1).

Figure 1. Danube River (Kudelin village and Koshava village)

The village of Kudelin (44°11′30″N, 22°40′5″E) is the first settlement on the Bulgarian section of the Danube River (844 river km). The village of Koshava (44°4′0″N, 23°2′0″ E) is situated along the Danube River (807 river km).

A total of 155 specimens of *C. nasus* were collected throughout the year, of which 91 specimens in spring, 32 specimens in summer and 32 specimens in autumn (Table 1).

Table 1. Number of *Chondrostoma nasus* specimens studied by biotopes from the Danube River

Season (N = 155)	Kudelin	Koshava
Spring (N = 91)	49	42
Summer (N = 32)	32	–
Autumn (N = 32)	32	–

The fish were caught under a fishing permit for scientific research by the Executive Agency for Fisheries and Aquaculture, the Ministry of Agriculture, Food and Forests in Bulgaria. Species belonging to the studied fish specimens were determined by Karapetkova and Jivkov (2006); Kottelat and Freyhof (2007). The scientific name of the species is written by Froese and Pauly (2019). Metric data (weight (g) in grams, maximum body length (L) in centimetres and maximum body width (H) in centimetres) for all examined specimens *C. nasus* were determined (Table 2).

Table 2. Metric data (L, H and g) of the examined specimens *C. nasus* by biotopes from the Danube River

Chondrostoma nasus	Spring		Summer	Autumn
	Koshava	Kudelin	Kudelin	Kudelin
L Average ± SD	29.91 ± 4.95	31.15 ± 3.55	26.59 ± 3.06	30.25 ± 2.88
H Average ± SD	6.52 ± 1.30	6.54 ± 0.85	5.90 ± 0.61	6.70 ± 0.91
g Average ± SD	244.98 ± 129.71	277.11 ± 78.73	162.09 ± 46.23	274.25 ± 77.77

The collected specimens of common nase from both biotopes were examined for multicellular endoparasites. Helminthological investigations were performed according to Petrochenko (1956); Zashev and Margaritov (1966); Kakacheva-Avramova (1983); Bauer (Ed.) (1987); Moravec (2013). The isolated endoparasites were fixed and stored in 70 % ethyl alcohol. Permanent microscope preparations were prepared by the representatives of the class Trematoda and class Cestoda according to the method of Georgiev et al. (1986) and Scholz and Hanzelova (1998), and temporary microscope preparations were prepared by the representatives of class Nematoda and class Acanthocephala (Zashev

and Margaritov, 1966; Moravec, 2013). Prevalence (P %), mean intensity (MI) and mean abundance (MA) were determined for each parasite species. The structure of the component parasite communities was determined according to the criteria proposed by Kennedy (1993) and Bush et al. (1997). Based on prevalence (P %), species are divided into accidental (P % < 10), component (10 < P % < 20), and core (P % > 20). The infracommunities are analyzed based on indicators: total number of species, the mean number of endoparasites, the Brillouin's diversity index (HB) (Magurran, 1998). The calculations were performed with MS Excel (Microsoft 2010) and Statistica 10 (StatSoft Inc., 2011).

RESULTS AND DISCUSSIONS

A total of 155 specimens of *Chondrostoma nasus* (Linnaeus, 1758) from the Danube River were captured and investigated. The common nase is a species of the family Cyprinidae. On the territory of Bulgaria, the species was found in the Danube River and its tributaries.

The common nase is a freshwater fish that can be found in rivers with a moderate course. Fish eat plant materials. It reaches maximum body length up to 50 cm and weight up to 1 kg, rarely from 2 to 2.5 kg (Karapetkova and Jivkov, 2006; Kottelat and Freyhof, 2007).

Helminth community structure

Endoparasites were found in 125 specimens (80.65%) of all 155 examined specimens common nase from the Danube River.

In the spring, 74 specimens (81.32%) of 91 studied specimens *C. nasus* were infected, in the summer, 24 specimens (75%) of 32 specimens *C. nasus* were infected, and 27 specimens (84.38%) of 32 specimens *C. nasus* were infected in the autumn.

In all 155 studied specimens *C. nasus*, eight species of parasites were established: two species of the class Trematoda (*Allocreadium isoporum* (Looss, 1894), *Sphaerostomum bramae* (Müller, 1776)); one species of the class Cestoda (*Bothriocephalus acheilognathi* (Yamaguti, 1934), immature); one species from the class Acanthocephala (*Pomphorhynchus laevis* (Müller, 1776)); four species from the class Nematoda (*Raphidascaris acus* (Bloch, 1779), larvae; *Contracaecum* sp., larvae; *Hysterothylacium* sp., larvae; *Pseudocapillaria tomentosa* (Dujardin, 1843)) (Table 3).

Table 3. Species diversity of *Chondrostoma nasus* parasites by seasons and biotopes from the Danube River

Parasite species	Spring		Summer	Autumn
	Koshava	Kudelin	Kudelin	Kudelin
Allocreadium isoporum (Looss, 1894)	•	•		
Sphaerostomum bramae (Müller, 1776)				•
Bothriocephalus acheilognathi (Yamaguti, 1934), immature	•	•		
Pomphorhynchus laevis (Müller, 1776)	•	•		
Raphidascaris acus (Bloch, 1779), larvae	•	•	•	
Contracaecum sp., larvae	•	•	•	•
Hysterothylacium sp., larvae		•		
Pseudocapillaria tomentosa (Dujardin, 1843)		•		

Component community

In the component community of *C. nasus* from the Danube River (Koshava and Kudelin biotopes), nematodes (4 species with 2,056 specimens) are represented with the most significant number of specimens, followed by trematodes (2 species with 15 specimens), cestodes (1 species with 10 specimens) and acanthocephalans (1 species with 7 specimens).

Five species of parasites were detected in common nase from Koshava biotope: *Allocreadium isoporum*, *Bothriocephalus acheilognathi*, *Pomphorhynchus laevis*, *Raphidascaris acus*, larvae and *Contracaecum* sp., larvae. The nematodes *Contracaecum* sp.

(P % = 40.48) and *R. acus* (P % = 30.95) are core parasite species in the parasite communities of common nase. The trematode *A. isoporum* (P % = 11.90) is a component parasite species. Whereas the cestode *B. acheilognathi* (P % = 7.14) and the acanthocephalan *P. laevis* (P % = 2.38) are accidental parasite species in the parasite communities of common nase from Koshava biotope. The highest mean intensity (MI) has *R. acus* (MI = 8.69), and the highest mean abundance (MA) has *Contracaecum* sp. (MA = 3.48) (Table 4).

Table 4. Species diversity and main ecological terms of parasites and parasite communities of *Chondrostoma nasus* from the Danube River, Koshava biotope

Parasite species	Koshava N = 42					
	n	p	MI	MA	P %	Range
Allocreadium isoporum	5	5	1.00	0.12	11.90	1
Bothriocephalus acheilognathi, immature	3	7	2.33	0.17	7.14	1–4
Pomphorhynchus laevis	1	6	6.00	0.14	2.38	6
Raphidascaris acus, larvae	13	113	8.69	2.69	30.95	1–34
Contracecum sp., larvae	17	146	8.59	3.48	40.48	1–79

N – number of studied fish hosts, n – number of infected fish hosts, p – number of fish parasites, MI – mean intensity, MA – mean abundance, P % – prevalence.

Eight species of parasites were detected in common nase from Kudelin biotope: *Allocreadium isoporum*, *Sphaerostomum bramae*, *Bothriocephalus acheilognathi*, immature, *Pomphorhynchus laevis*, *Raphidascaris acus*, larvae, *Contracaecum* sp., larvae, *Hysterothylacium* sp., larvae and *Pseudocapillaria tomentosa*. The nematodes *Contracaecum* sp. (P % = 66.37) and *R. acus* (P % = 20.35) are core parasite species in the parasite communities of common nase from this biotope. The other six parasite species are accidental in the parasite communities of common nase from Kudelin biotope. The highest mean intensity (MI) and the highest mean abundance (MA) has *Contracaecum* sp. (MI = 22.68; MA = 15.05) (Table 5).

Table 5. Species diversity and main ecological terms of parasites and parasite communities of *Chondrostoma nasus* from the Danube River, Kudelin biotope

Parasite species	Kudelin N = 113					
	n	p	MI	MA	P %	Range
Allocreadium isoporum	4	6	1.50	0.05	3.54	1–2
Sphaerostomum bramae	3	4	1.33	0.04	2.65	1–2
Bothriocephalus acheilognathi, immature	2	3	1.50	0.03	1.77	1–2
Pomphorhynchus laevis	1	1	1.00	0.01	0.88	1
Raphidascaris acus, larvae	23	90	3.91	0.80	20.35	1–14
Contracecum sp., larvae	75	1,701	22.68	15.05	66.37	1–315
Hysterothylacium sp., larvae	2	4	2.00	0.04	1.77	1–3
Pseudocapillaria tomentosa	1	2	2.00	0.02	0.88	2

N – number of studied fish hosts, n – number of infected fish hosts, p – number of fish parasites, MI – mean intensity, MA – mean abundance, P % – prevalence.

Only from Kudelin biotope were taken samples during the three seasons (spring, summer and autumn). During all seasons in this biotope were found parasite species on *C. nasus* from the Danube River. Invasion with *Contracaecum* sp. were found throughout the study period. *A. isoporum*, *B. acheilognathi*, *P. laevis*, *P. tomentosa,* and *Hysterothylacium* sp., were found only during the spring season. *S. bramae* was established only in the autumn. One specimen of *P. laevis* was found in one specimen of *C. nasus* in the spring. In the component community of common nase from Kudelin biotope, *Contracaecum* sp. has the highest number of specimens (1,701) and the highest mean intensity (MI) in all seasons (spring MI = 36.38; summer MI = 17.88 and autumn MI = 14.78). The highest number of parasite species (7 species) and the highest number of parasite specimens (978) were collected and established in the spring. The dominant parasite species in all three seasons is *Contracaecum* sp. (Table 6).

Table 6. Seasonal differences in species composition on endoparasites and invasion indices of *Chondrostoma nasus* from the Danube River, Kudelin biotope

Season	**Spring (N = 49)**				**Summer (N = 32)**				**Autumn (N = 32)**			
Parasite species	**n/p**	**MI**	**MA**	**P % (Range)**	**n/p**	**MI**	**MA**	**P % (Range)**	**n/p**	**MI**	**MA**	**P % (Range)**
A. isoporum	4/6	1.50	0.12	8.16 (1–2)	–	–	–	–	–	–	–	–
S. bramae	–	–	–	–	–	–	–	–	3/4	1.33	0.13	9.38 (1–2)
***B. acheilognathi*, immature**	2/3	1.50	0.06	4.08 (1–2)	–	–	–	–	–	–	–	–
P. laevis	1/1	1.00	0.02	2.04 (1)	–	–	–	–	–	–	–	–
***R. acus*, larvae**	22/89	4.05	1.82	44.90 (1–14)	1/1	1.00	0.03	3.13 (1)	–	–	–	–
***Contracaecum* sp., larvae**	24/873	36.38	17.82	48.98 (3–315)	24/429	17.88	13.41	75.00 (1–65)	27/399	14.78	12.47	84.38 (1–66)
***Hysterothylacium* sp., larvae**	2/4	2.00	0.08	4.08 (1–3)	–	–	–	–	–	–	–	–
P. tomentosa	1/2	2.00	0.04	2.04 (2)	–	–	–	–	–	–	–	–

N – number of studied fish hosts, n – number of infected fish hosts, p – number of fish parasites, MI – mean intensity, MA – mean abundance, P % – prevalence.

Infracommunity

Of all 155 examined specimens *C. nasus* from the Danube River (Koshava and Kudelin biotopes), 30 specimens (19.35 %) were not infected, and 125 specimens (80.65 %) were infected, as of them the 104 specimens (67.10%) were infected with one species of parasite, 18 specimens (11.61%) with two species of parasites, 2 specimens (1.29%) – with three species of parasites and 1 specimen (0.65%) – with four species of parasites (Table 7).

In the infracommunities of *C. nasus* from the Danube River, Koshava biotope, the number of endoparasite specimens ranged from 1 to 79 in one specimen host.

In contrast, in the infracommunities of *C. nasus* from the Danube River, Kudelin biotope, the number of endoparasite specimens ranged from 1 to 315 in one specimen host.

A total of 2,088 specimens of endoparasites were studied.

The Brillouin's diversity index for the studied sample of the two biotopes is 0.37, ranging from 1.04 to 0.01 for the spring and autumn seasons, with an average value of 0.05 for the summer season (Table 7).

Table 7. Infracommunity of *Chondrostoma nasus* from the Danube River

Number of specimens *Chondrostoma nasus*	Number of parasite species				
	0	**1**	**2**	**3**	**4**
	30	104	18	2	1
Total number of species (Mean number of species ± SD)	8 (0.97 ± 0.65)				
Total number of specimens (Mean number of specimens ± SD)	2,088 (160.62 ± 465.51)				
Brillouin's diversity index (HB)	0.37 ± 0.58				

CONCLUSIONS

As a result of the study of 155 specimens *C. nasus* caught from the Danube River, 8 parasite species were identified: *A. isoporum*, *S. bramae*, *B. acheilognathi*, *P. laevis*, *R. acus*, larvae, *Contracaecum* sp., larvae, *Hysterothylacium* sp., larvae, *P. tomentosa*. *C. nasus* was reported as a new host for *A. isoporum, S. bramae, B. acheilognathi, R. acus, Contracaecum sp., Hysterothylacium sp.* and *P. tomentosa* from the Bulgarian section of the Danube River.

The largest number of parasite species (8 species) were found in the studied specimens *C. nasus* from Kudelin biotope.

In the component community of common nase from Koshava biotope, *R. acus* has the highest mean intensity (MI = 8.69) and *Contracaecum* sp. has the highest mean abundance (MA = 3.48). *Contracaecum* sp. (P % = 40.48) and *R. acus* (P % = 30.95) are core species in the endoparasite communities of *C. nasus* from Koshava biotope. *C. nasus* from Kudelin biotope was examined all three seasons.

The species diversity of endoparasites was highest during the spring study period. Of them, with the highest mean intensity and mean abundance is distinguished *Contracaecum* sp. (MI = 36.38; MA = 17.82). *Contracaecum* sp. is core species in the parasite communities of common nase during spring, summer and autumn (P % = 48.98, P % = 75.00 and P % = 84.38, respectively). *R. acus* is also core species in the parasite communities of common nase but is only found for the spring season (P % = 44.90).

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