Scientific Papers. Series D. Animal Science. Vol. LXIX, No. 1, 2026
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

PARASITES AND PARASITE COMMUNITIES OF FRESHWATER FISH FROM THE LUDA YANA RIVER

Diana KIRIN[1, 2], Radoslava ZAHARIEVA[2], Petya ZAHARIEVA[2], Dimitrinka KUZMANOVA[1], Mariya CHUNCHUKOVA[1]

[1]Agricultural University-Plovdiv, Department of Chemistry, Phytopharmacy and Ecology, and Environmental Protection, 12 Mendeleev Blvd, Plovdiv, 4000, Bulgaria
[2]National Institute of Geophysics, Geodesy and Geography (NIGGG), Hydrology and Water Management Research Center, Bulgarian Academy of Sciences, Acad. G. Bonchev Street, bl. 3, Sofia, 1113, Bulgaria

Corresponding author email: dianaatanasovakirin@gmail.com

Abstract

The aim of the study is to investigate and track 1) differences in parasite communities between mining-influenced biotopes versus wastewater impacts, and 2) expected relationships between parasite load and Fulton condition factor. The species composition and dominant structure of the fish complexes in the two biotopes were compared. The dominant species in both biotopes is Alburnus alburnus (Linnaeus, 1758), followed by Barbus cyclolepis Heckel, 1837. All specimens of the identified fish species were examined for parasites using standard methods. The dominant structure of the parasite communities is discussed at the level of component communities and infracommunities. A common parasite species for both biotopes is Acanthocephalus anquillae (Müller, 1780) Lühe, 1911. The similarity of the fish and parasite communities in both biotopes is presented. The factors influencing their formation are analysed. Alb. aburnus from the Luda Yana River is a new host for four parasite species: Rutilus rutilus (Linnaeus, 1758), B. cyclolepis and Gobio gobio (Linnaeus, 1758), for one parasite species each. Biotope Svoboda is a new habitat for five parasite species, and biotope Pazardzhik – for three species.

Key words*: component parasite communities, dominant structure, fish species, parasite infracommunities, similarity.*

INTRODUCTION

The Luda Yana River is 74 km long, which ranks it among the largest tributaries of the Maritsa River. The Luda Yana River springs from Sashtinska Sredna Gora, crosses the Pazardzhik-Plovdiv field and flows to the left of the Maritsa River, in the area of the village of Sinitovo, Pazardzhik municipality (Kiradzhiev, 2013; Kolev, 2020). Kolev (2013; 2020) reports on the ichthyofauna of the river eight native fish species (*Squalius orpheus* Kottelat & Economidis, 2006; *Barbus cyclolepis* Heckel, 1837; *Salmo* sp.; *Rutilus rutilus* (Linnaeus, 1758); *Gobio bulgaricus* Drensky, 1926; *Perca fluviatilis* Linnaeus, 1758; *Alburnus alburnus* (Linnaeus, 1758); *Cobitis strumicae* Karaman, 1955) and three alien fish species (*Carassius gibelio* (Bloch, 1782); *Lepomis gibbosus* (Linnaeus, 1758); *Pseudorasbora parva* (Temminck & Schlegel, 1846). Fish are of great importance to ecosystem biodiversity (Kumar et al., 2025). Parasites use a variety of fish species as intermediate and definitive hosts in their life cycles (Lehun et al., 2023). Parasites are organisms that live in or on other organisms from which they derive benefits, such as protection, food, and a place to live. On the one hand, they cause diseases. On the other hand, they contribute to biodiversity in ecosystems and have an important role in them, as they influence the dynamics of their host populations, the structure of host communities and trophic relationships (de Lima et al., 2025; Hasegawa & Poulin, 2025). Studies on the parasite fauna of fish from the Luda Yana River have been conducted by a few authors (Kirin, 2002; Kirin et al., 2019; Zaharieva, 2023; Zaharieva et al., 2024).

The aim of the study is to investigate and track 1) differences in parasite communities between mining-influenced biotopes versus wastewater impacts, and 2) expected relationships between parasite load and Fulton condition factor.

MATERIALS AND METHODS

In the spring of 2025, two places along the Luda Yana River were visited – Svoboda and Pazardzhik (designated as biotopes). The Svoboda biotope (42°23'59.1"N 24°17'31.2"E) is located in the middle reaches of the river near the Radka copper ore deposit (part of the Panagyurishte ore region). The mine's operations were suspended in 1995. The Pazardzhik biotope (42°09'38.8"N 24°22'52.0"E) is located in the lower reaches of the Luda Yana River, before its confluence with the Maritsa River. The selected biotope is located near the wastewater treatment plant (WWTP) of the town of Pazardzhik (Figures 1-2).

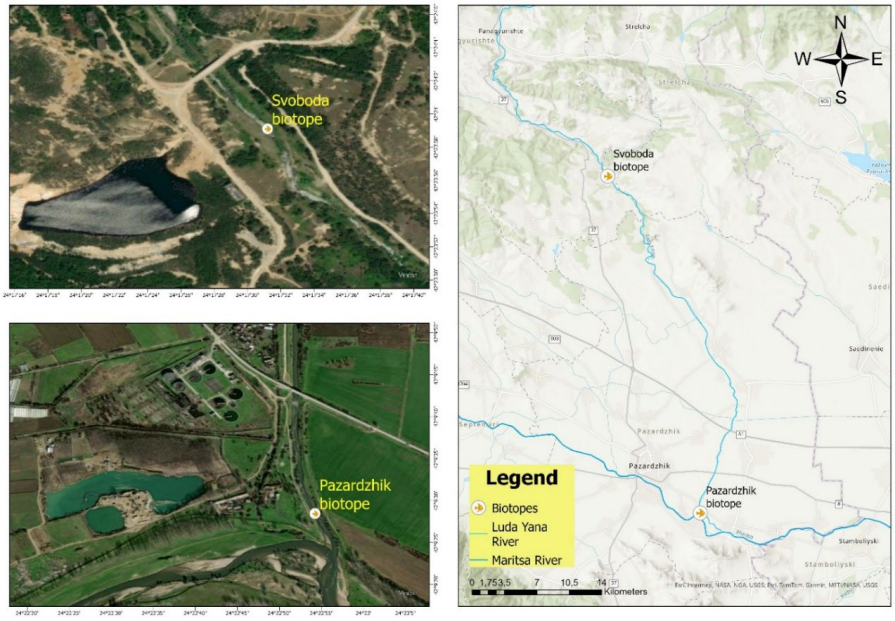

Figure 1. Map of the studied biotopes from the Luda Yana River (own source)



Figure 2. Photographs of the studied biotopes from the Luda Yana River (Svoboda and Pazardzhik – mouth; from left to right) (own source)

A total of 95 specimens of 6 fish species were caught (BDS EN 14757:2015) - Bleak *Alb. alburnus*, Round-scaled barbell *B. cyclolepis*, Gudgeon *Gobio gobio* (Linnaeus, 1758), Roach *R. rutilus*, Orpheus dace *Sq. orpheus* и European bitterling *Rhodeus amarus* (Bloch, 1782). Dominant species in both biotopes is *Alb. alburnus*. Fish species were identified according to Froese & Pauly (2025). The number of specimens of each species caught (N) is reflected; sex (male specimens - ♂; female specimens - ♀) and basic metric data (total body length (TL) in centimeters and body weight (BW) in grams) (Table 1).

Table 1. Metric data and numbers of the studied fish from the Luda Yana River

Biotope	Fish species	N	Sex	TL Min.-Max. (Mean±SD)	BW Min.-Max. (Mean±SD)
Svoboda	*Alburnus alburnus*	31	26 ♂; 5 ♀	7-12.2 (9.797±1.024)	4-12 (7.61±2.186)
	Barbus cyclolepis	25	24 ♂; 1 ♀	8.2-16 (9.608±1.479)	5-35 (9±5.694)
	Gobio gobio	5	2 ♂; 3 ♀	7.3-8.3 (7.7±0.4)	4-5 (4.6±0.548)
	Rutilus rutilus	1	1 ♂	8	4
	Squalius orpheus	1	1 ♂	12	15
Pazardzhik	*Alburnus alburnus*	30	19 ♂; 11 ♀	9-12 (10.423±0.722)	5-12 (7.53±2.113)
	Barbus cyclolepis	1	1 ♂	8.7	5
	Rhodeus amarus	1	1 ♂	5.3	3

A visual inspection of the fish body surface, abdominal cavity and all organs was performed. Organs were prepared and examined under a Micros Austria MZ 1240 stereomicroscope according to standard methodology (Zashev & Margaritov, 1966; Moravec, 2013). Temporary microscope slides with glycerin and permanent microscope slides with Canada balsam were prepared from the found parasites (Dubinina, 1948; Scholz & Hanzelová, 1998). With the XS-213 microscope, species determination of the established parasites was carried out according to Kakacheva-Avramova (1983), Moravec (2013), and others. The parasite communities of the dominant fish species in the two biotopes are presented at two levels: component community and infracommunity. Basic ecological indices (mean intensity (MI), mean abundance (MA) and prevalence (P%)) and diversity indices (Pielou's evenness index (J'), Simpson's index (D), and Simpson's index of diversity (1-D) according to McDonald, 2010; Okpiliya, 2012) were calculated and discussed. Fulton's condition factor (K) is presented. Fish with a Fulton's condition factor value above one are in good condition (Zencir Tanir, 2020). The relationship between sex and infection of *Alb. alburnus* from the Svoboda and Pazardzhik biotopes was studied (χ^2 test). The relationship between Fulton's condition factor and the number of parasites in the studied *Alb. alburnus* specimens from both biotopes was also studied (regression and correlation analysis). The statistical analysis of the data was carried out using IBM SPSS Statistics (Version 19).

RESULTS AND DISCUSSIONS

Species diversity of fish parasites from the Luda Yana River

In the present ecoparasitological study of 63 specimens of five fish species (Bleak, Round-scaled barbell, Gudgeon, Roach, Orpheus dace) from the Svoboda biotope and 32 specimens of three fish species (Bleak, Round-scaled barbell, European bitterling) from the Pazardzhik biotope, infection was found with 6 and 3 parasite species, respectively (Table 2).

Table 2. Species diversity of the isolated parasites from the Luda Yana River

Class/Phylum	Parasite species
TREMATODA	**Allocreadium isoporum* (Looss, 1894) Looss, 1902
CESTODA	**Caryophyllaeus brachycollis* Janiszewska, 1953 **Caryophyllaeides fennica* (Schneider, 1902) Nybelin, 1922
ACANTHOCEPHALA	****Acanthocephalus anguillae* (Müller, 1780) Lühe, 1911 ***Acanthocephalus tenuirostris* (Achmerov & Dombrovskaja-Achmerova, 1941) Yamaguti, 1963 ****Pomphorhynchus laevis* (Zoega in Müller, 1776) Porta, 1908
NEMATODA	**Rhabdochona denudata* (Dujardin, 1845) Railliet, 1916

Legend: * - a parasite found in Svoboda biotope; ** - a parasite found in the Pazardzhik biotope; *** - a parasite found in both biotopes.

In the study of *Alb. alburnus* from the Luda Yana River (Svoboda), 3 parasite species were found: *Caryophyllaeus brachycollis* Janiszewska, 1953; *Acanthocephalus anguillae* (Müller, 1780) Lühe, 1911; and *Rhabdochona denudata* (Dujardin, 1845) Railliet, 1916. In *B. cyclolepis* from Svoboda, 3 parasite species were established: *Allocreadium isoporum* (Looss, 1894) Looss, 1902; *Caryophyllaeides fennica* (Schneider, 1902) Nybelin, 1922 and *Ac. anguillae*. In *G. gobio* and *R. rutilus*, one parasite species was found: *Pomphorhynchus laevis* (Zoega in Müller, 1776) Porta, 1908 and *Ac. anguillae*, respectively. *Sq. orpheus* from the Svoboda biotope is free of parasites.

In the study of *Alb. alburnus* from the Luda Yana River (Pazardzhik), two parasite species were found: *Ac. anguillae* and *P. laevis*. One parasite species was found in *B. cyclolepis* – *Acanthocephalus tenuirostris* (Achmerov & Dombrovskaja-Achmerova, 1941) Yamaguti, 1963. *Rh. amarus* from the Pazardzhik biotope is free of parasites.

In the present study of 25 *B. cyclolepis* specimens from the Svoboda biotope, infection was observed in 44%. In 10 specimens of Round-scaled barbell, infection by a single parasite species was found, and in one specimen of fish, two parasite species were found. A total of 85 specimens of the three parasite species were studied. The number of *All. isoporum* in one specimen of *B. cyclolepis* varies from 2 to 22, and of *C. fennica* – from 2 to 34. Three specimens of *B. cyclolepis* were infected with one *Ac. anguillae* specimen each. Pielou's evenness index (J) indicates a high evenness in the distribution of parasites in the community. Simpson's dominance index (D) and Simpson's index of diversity (1-D) indicate moderate community diversity (Table 3).

Table 3. Indices of diversity of parasites of *Barbus cyclolepis* from Svoboda biotope

Indices	
Total number of species	3
Total number of specimens	85
Pielou's evenness index $J' = \frac{H'}{H_{max}} = \frac{H'}{\ln S}$	0.75
Simpson's index $D = \sum \left(\frac{n}{N}\right)^2$	0.47
Simpson's index of diversity (1-D)	0.54

In one specimen of *B. cyclolepis* from the Pazardzhik biotope, one *Ac. tenuirostris* specimen was found. During parasitological examination of five *G. gobio* specimens from the Svoboda biotope, infection was found in only one specimen of *G. gobio* (20%) with one specimen of *P. laevis*. In one *R. rutilus* specimen from the same biotope, infection with one *Ac. anguillae* was found.

Component communities of parasites of Alburnus alburnus from the Luda Yana River

In the component communities of Bleak from the Svoboda and Pazardzhik biotopes, the largest numbers of specimens are acanthocephalans: 12 of one species and 73 of two species, respectively. In the Pazardzhik biotope, no infections of Cestoda and Nematoda were found. In the two studied biotopes, no infection of Trematoda was found. In the parasite community of *Alb. alburnus* from the Svoboda biotope, one core parasite species (P%>20), one component (10<P%<20), and one accidental parasite species (P%<10) were found (according to Kennedy, 1993). Both parasite species found in the Pazardzhik biotope are the core species in the parasite community of *Alb. alburnus*. The highest mean intensity in the Svoboda biotope has the cestode species *C. brachycollis*, and in the Pazardzhik biotope, the acanthocephalan species *P. laevis* (Table 4).

Table 4. Component communities of *Alburnus alburnus* from the Luda Yana River

Biotope	**Svoboda**						**Pazardzhik**					
Fish species	*Alburnus alburnus* (N = 31)						*Alburnus alburnus* (N = 30)					
Parasite species	**n**	**p**	**MI**	**MA**	**P%**	**R**	**n**	**p**	**MI**	**MA**	**P%**	**R**
Caryophyllaeus brachycollis	3	8	2.67	0.26	9.68	1-5	-	-	-	-	-	
Acanthocephalus anguillae	7	12	1.71	0.39	22.58	1-5	20	55	2.75	1.83	66.67	1-7
Pomphorhynchus laevis	-	-	-	-	-	-	6	18	3.00	0.60	20.00	2-5
Rhabdochona denudata	4	5	1.25	0.16	12.90	1-2	-	-	-	-	-	

Legend: N - number of examined fish, n - number of infected fish, p - number of fish parasites, MI - mean intensity, MA - mean abundance, P% - prevalence, R – range

Infracommunities of parasites of Alburnus alburnus from the Luda Yana River

In the present ecoparasitological study of 31 specimens of Bleak from the Svoboda biotope, parasites were found in 12 specimens of fish. Of these, 10 specimens were infected with one parasite species, and two specimens with two parasite species. Three Bleak specimens were infected with 1, 2, and 5 *C. brachycollis* specimens, respectively. Five specimens of Bleak were infected with one *Ac. anguillae* specimen. Two specimens of Bleak were infected with two and five *Ac. anguillae* specimens, respectively. Three and one Bleak specimens were infected with one and two *Rh. denudata* specimens, respectively. In *Alb. alburnus* from the Svoboda biotope, infection with three parasite species (25 specimens) was found, and their number in one Bleak specimen varied from 1 to 5 specimens. Simpson's index (D) indicates moderate diversity in the parasite community of *Alb. alburnus* from the Svoboda biotope, with dominance of two parasite species. The value of Pielou's evenness index (J') indicates a very high evenness in the distribution.

During the examination of 30 specimens of Bleak from the Pazardzhik biotope, infection was found in 24 specimens. Twenty-two specimens of Bleak were infected with one parasite species, and two specimens were infected with two parasite species. In 8, 3, 3, 2, 1, 2, and 1 Bleak specimen, 1, 2, 3, 4, 5, 6, and 7 *Ac. anguillae* specimens were found, respectively. Two, three, and one Bleak specimens were infected with 2, 3, and 5 *P. laevis* specimens, respectively. In *Alb. alburnus* from the Pazardzhik biotope, two parasite species were found with a total of 73 specimens. The number of parasite specimens in one Bleak specimen varies from 1 to 7. Simpson's index (D) shows low diversity in the parasite community of *Alb. alburnus* from the Pazardzhik biotope, with the dominance of one species (*Ac. anguillae*).

Pielou's evenness index (J') reports a high evenness in the distribution of specimens in the parasite community (Table 5).

Table 5. Infracommunities of *Alburnus alburnus* from the Luda Yana River

	Svoboda			**Pazardzhik**		
	Number of parasite species			**Number of parasite species**		
	0	1	2	0	1	2
Number of specimens *Alb. alburnus*	19	10	2	6	22	2
Total number of species (Mean number of species ± SD)	3 (0.45±0.65)			2 (0.87±0.49)		
Total number of specimens (Mean number of specimens ± SD)	25 (0.81±1.35)			73 (2.43±2.32)		
Range	1-5			1-7		
Pielou's evenness index (J')	0.95			0.81		
Simpson's index (D)	0.37			0.63		

A moderate relationship was found between the sex of Bleak specimens (Svoboda and Pazardzhik biotopes) and infection (Sig<0.05; Cramer's $V_{Svoboda}$=0.372, Cramer's $V_{Pazardzhik}$=0.380). In both biotopes, higher infection was found in female Bleak specimens. All female Bleak specimens from the Pazardzhik biotope were infected. Male Bleak specimens from the Pazardzhik biotope are more infected than those from the Svoboda biotope (Figure 3).

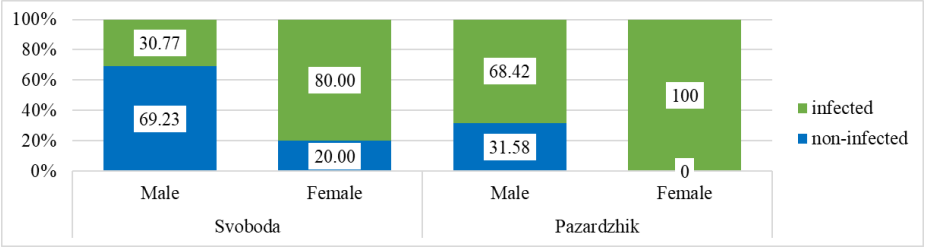

Figure 3. Infected male and female *Alburnus alburnus* specimens (in %) from Svoboda and Pazardzhik biotopes

According to the obtained mean values for Fulton's condition factor, *G. gobio* from Svoboda is in the best condition (K=1.01±0.12). In close to good condition are *B. cyclolepis* and *R. rutilus* again from the Svoboda biotope (Table 6).

Table 6. Fulton's condition factor (K)

Biotope	Fish species	K Min.-Max. (Mean±SD)
Svoboda	*Alburnus alburnus*	0.55-1.17 (0.80±0.14)
	Barbus cyclolepis	0.79-1.14 (0.95±0.08)
	Gobio gobio	0.87-1.19 (1.01±0.12)
	Rutilus rutilus	0.87
	Squalius orpheus	0.78
Pazardzhik	*Alburnus alburnus*	0.38-1.10 (0.66±0.14)
	Barbus cyclolepis	0.76
	Rhodeus amarus	2.02

The regression (Linear model; Figure 4) and correlation analysis (Pearson's correlation coefficient) report the presence of a moderate inverse relationship between the values of Fulton's condition factor and Number of Bleak parasites from the Svoboda biotope (Sig.=0.014<0.05; R=0.435; Pearson Correlation=-0.435). The analysis shows that 18.9% of the differences in the Number of fish parasites in the Svoboda biotope are explained by Fulton's condition factor values. For the Pazardzhik biotope, no relationship was established between Fulton's condition factor and the Number of fish parasites (Sig.=0.860>0.05; R=0.034).

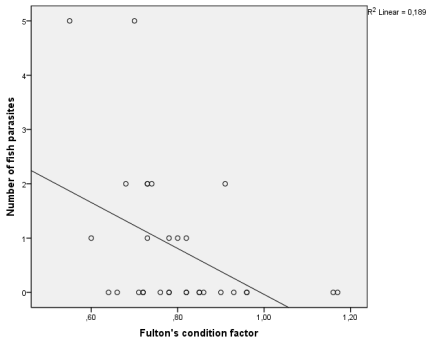

Figure 4. Linear model of the relationship between Fulton's condition factor and Number of *Alburnus alburnus* parasites from Svoboda biotope

Discussions

Of the 7 parasite species identified in the present study, six species (*All. isoporum*, *C. fennica*, *Ac. anguillae*, *C. brachycollis*, *P. laevis* and *Rh. denudata*) have been reported for different fish species from the Luda Yana River. While one species (*Ac. tenuirostris*) has not been reported as a parasite of fish from the Luda Yana River (Table 7).

Table 7. Parasite species in fish from the Luda Yana River from the study and according to other authors

Present study	Previous studies	
Parasite (Fish host / Biotope)	**Fish host / Biotope**	**Author**
TREMATODA		
All. isoporum (*B. cyclolepis* / Svoboda)	**** B. cyclolepis*** / Panagyurishte	Kirin (2002)
CESTODA		
C. fennica (*B. cyclolepis* / Svoboda)	*R. rutilus* / Popintsi	Kirin et al. (2019)
	Sq. orpehus / Popintsi	Zaharieva (2023)
	Sq. orpehus / Popintsi **** B. cyclolepis*** / ****Svoboda**	Zaharieva et al. (2024)
C. brachycollis (*Alb. alburnus* / Svoboda)	*B. cyclolepis* / Panagyurishte	Kirin (2002)
ACANTHOCEPHALA		
Ac. anguillae (*Alb. alburnus* / Svoboda, Pazardzhik; *B. cyclolepis* / Svoboda; *R. rutilus* / Svoboda)	**** B. cyclolepis*** / Panagyurishte	Kirin (2002)
Ac. tenuirostris (*B. cyclolepis* / Pazardzhik)	-	-
P. laevis (*Alb. alburnus* / Pazardzhik; *G. gobio* / Svoboda)	*Sq. orpehus* / Chernogorovo	Zaharieva et al. (2024)

Present study	Previous studies	
Parasite (Fish host / Biotope)	**Fish host / Biotope**	**Author**
NEMATODA		
Rh. denudata (*Alb. alburnus* / Svoboda)	*R. rutilus* / Popintsi	Kirin et al. (2019)
	Sq. orpehus / Popintsi	Zaharieva (2023)
	Sq. orpehus / Popintsi	Zaharieva et al. (2024)

Legend: * - host match; ** - biotope match

In this study, single specimens of two fish species from the Svoboda biotope (Roach, Orpheus dace) and two fish species from the Pazardzhik biotope (Round-scaled barbell, European bitterling) were studied; the results for these species are purely descriptive, and conclusions for them cannot be extrapolated.

CONCLUSIONS

During the parasitological examination of 31 specimens of Bleak, 25 specimens of Round-scaled barbell, 5 specimens of Gudgeon, one specimen of Roach and one specimen of Orpheus dace from the Svoboda biotope, and 30 specimens of Bleak, one specimen of Round-scaled barbell and one specimen of European bitterling from the Pazardzhik biotope, infection was found with a total of 7 parasite species with 186 specimens. *Sq. orpheus* and *Rh. amarus* are free of parasites. In the parasite community of *Alb. alburnus* from the Svoboda biotope, one core, one component and one accidental parasite species were found. In the Pazardzhik biotope, both parasites found in Bleak are core species. In both biotopes, higher infection was found in female Bleak specimens. Svoboda and Pazardzhik biotopes are new habitats for five and three parasite species, respectively, in the present study. *Alb. aburnus* from the Luda Yana River is a new host record for the parasite species *C. brachycollis*, *Ac. anguillae*, *P. laevis* and *Rh. denudata*; *R. rutilus* – for *Ac. anguillae*; *B. cyclolepis* – for *Ac. tenuirostris,* and *G. gobio* – for *P. laevis*.

ACKNOWLEDGEMENTS

This work has been carried out in the framework of the National Science Program "Critical and strategic raw materials for a green transition and sustainable development", approved by the Resolution of the Council of Ministers № 508/18.07.2024 and funded by the Ministry of Education and Science (MES) of Bulgaria.

REFERENCES

BDS EN 14757:2015 *Water quality - Sampling of fish with multi-mesh gillnets*

de Lima, V. M. M., de Mendonça-Filho, J. C. G., Lima, M. D. O., Honório, L. C. B., Falkenberg, J. M., Yamada, F. H., Yamada, P. O. F., Lustosa-Costa, S. Y., Ramos, T. P. A., Teixeira de Mello, F., Menezes, R. F., Windsor, F. M., & Lacerda, A. C. F. (2025). Unveiling new data on fish parasite diversity in reservoirs of the Brazilian semi-arid. *Journal of Helminthology*, *99*(e56), 1–11.

Dubinina, M. N. (1948). Parasite fauna of the wild gray goose (*Anser anser*). *Parasitol. Sat. Zool. Institute of the Academy of Sciences of the USSR, 12*, 300–351 (in Russian).

Froese, R., & Pauly, D. (2025, November). *FishBase. World Wide Web electronic publication. Retrieved from www.fishbase.org*.

Hasegawa, R., & Poulin, R. (2025). Effect of parasite infections on fish body condition: a systematic review and meta-analysis. *International journal for parasitology*, *55*(8–9), 417–426.

Kakacheva-Avramova, D. (1983). *Helminths of freshwater fish in Bulgaria*. Izdatelstvo na Balgarskata Akademiya na Naukite, Sofia, 261 p. (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.

Kiradzhiev, S. (2013). *Encyclopedic Geographical Dictionary of Bulgaria.* Sofia, BG: Iztok-zapad Publishing house (in Bulgarian).

Kirin, D., Chunchukova, M., & Kuzmanova, D. (2019). Endohelmiths and endohelminth communities of *Rutilus rutilus* (Linnaeus, 1753) from anthropogenic loaded ecosystem of the Luda Yana River, Bulgaria. *Scientific Papers. Series D, Animal Science, 62*(1), 469–474.

Kirin, D.A. (2002). Biodiversity and ecological characteristics of the helminth communities in *Barbus tauricus cyclolepis* from Luda Yana River, Bulgaria. *Comptes Rendus de l'Academie Bulgare des Sciences, 55*(5), 97–102.

Kolev, V. I. (2020). Alien Fishes in Some Tributaries of the Maritsa River in Bulgaria. *Ecologia Balkanica*, *12*(1), 21–30.

Kolev, V. (2013). Species composition of the ichthyofauna of some tributaries of the Maritza River. *Forestry ideas*, *19*(46), 129–139.

Kumar, V., Sharma, A., Ram, R. K., Kumar, S., & Singh, S. K. (2025). Assessment of Fish Diversity Associated with Water Quality Parameters of Burhi Gandak River, North Bihar, India. *Uttar Pradesh Journal of Zoology*, *46*(6), 6–17.

Lehun, A. L., Silva, J. O. S., Michelan, G., Lansac-Tôha, F. M., Cavalcanti, L. D., & Takemoto, R. M. (2023). The occurrence of trophically transmitted parasites is influenced by the trophic level and body size of the fish host. *Ecology of Freshwater Fish*, *32*(3), 648–655.

McDonald, C., R. Smith, M. Scot, and J. Dick (2010, 06). Using indices to measure biodiversity change through time. In *5th METMA Santiago de Compostela*, Spain, June-July 2010, pp. 1–5. International Workshop on Spatial-Temporal Modeling.

Moravec, F. (2013). *Parasitic nematodes of freshwater fishes of Europe*. Praha, CZ: Academia Publishing House.

Okpiliya, F. I. (2012). Ecological diversity indices: Any hope for one again. *Journal of Environment and Earth Science, 2*(10), 45–52.

Scholz, T., & Hanzelová, V. (1998). *Tapeworms of genus Proteocephalus Weinland, 1858 (Cestoda; Proteocephalidae), parasites of fish in Europe*. Praha, CZ: Academy of Sciences of the Czech Republic Publishing House, 117.

Zaharieva, P. (2023). Parasites and parasite communities of *Squalius orpheus* Kottelat & Economidis, 2006 from the Luda Yana River. *Scientific Papers. Series D. Animal Science, LXVI* (2), 686–695.

Zaharieva, R., Kirin, D., & Zaharieva, P. (2024). Helmintological study of fish from the freshwater ecosystems of the Luda Yana River and Chepelarska River. *Scientific Papers. Series D. Animal Science, LXVII* (2), 668–675.

Zashev, G., & Margaritov, N. (1966). *Diseases of fish*. Sofia, BG: Nauka i izkustvo Publishing House (in Bulgarian).

Zencir Tanir, Ö. (2020). Length-Weight Relationships and Fulton's Condition Factor of Common carp (Cyprinus carpio L., 1758) from Tercan Dam Lake, Eastern Anatolia, Turkey. *Erzincan University Journal of Science and Technology, 13*(2), 609–619.