AQUATIC RESEARCH

AQUATIC RESEARCH
E-ISSN 2618-6365

Aquat Res 5(2), 154-164 (2022) • https://doi.org/10.3153/AR22015 Research Article

Crustacean and Protozoan parasites of some Cyprinid fish living in the Murat River (Bingöl-Türkiye), with new host records

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Cite this article as:
Korkut, N., Koyun, M. (2022). Crustacean and protozoan parasites of some cyprinid fish living in the Murat River (Bingöl-Türkiye), with new host records. *Aquatic Research*, 5(2), 154-164. https://doi.org/10.3153/AR22015

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Submitted: 14.02.2022
Revision requested: 23.02.2022
Last revision received: 15.03.2022
Accepted: 21.03.2022
Published online: 23.03.2022

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Available online at
http://aquatres.scientificwebjournals.com

ABSTRACT

Some Cyprinid fish species: *Cyprinion macrostomum* (Heckel, 1843), *Capoeta umbla* (Heckel, 1843), *Chondrostoma regium* (Heckel, 1843), and *Squalius cephalus* (Linnaeus, 1758) living naturally in the Murat River, were investigated for Protozoan and Crustacean parasite fauna and their distribution. Fish samples were collected from different stations between July 2017 - June 2019, examined in the Bingöl University Zoology Research Laboratory, and the data were explained with various variables. The normality test revealed that the data were not normally distributed ($p < 0.05$), as with large samples, so non-parametric tests explained the data. A total of 365 fish were examined, and 100 fish (27.4%) were infected with at least one Protozoan or Crustacean parasite. Four different parasite species were recorded on the examined fish, namely *Ichthyophthirius multifiliis* and *Trichodina* sp. belonging to the phylum Ciliophora (Protozoan), *Ergasilus sieboldi*, and *Lamproglena pulchella* belonging to the phylum Arthropoda (Crustacean). As a result of this study, for the first time, Protozoan and Crustacean parasites of different cyprinid fish were examined according to the host species, seasonal distribution, host size, and new host records were reported for three parasites.

Keywords: Crustacean, Protozoan, Fish parasites, Cyprinid, Murat River

Introduction

Fishing has a vital place to provide the animal product needs of a country. It is also imperative to know the parasites that cause severe economic losses in the fish population. Investigation of fish diseases, parasites, and treatments are essential for today's fish industry and fish farming. The importance of fish parasites is directly related to the economic value of the fish species they affect. Diseases caused by parasites reduce fish immunity against dangerous infections and negatively affect growth, development, egg production, and meat quality. They can also cause infectious diseases and mass death of fish (Grabda, 1991).

It is known that approximately 10 thousand species of parasites live in fish. They are 27% Crustacea, 18% Protozoa, 17% Digenea, 15% Monogenea, 10% Cestoda, 7% Nematoda, 4% Acanthocephala and 1% Huridinea (Cengizler, 2000). Parasitic creatures in nature indicate biological events such as feeding and migration in their host and give some ideas about their environment. By identifying the hosts in the life cycle of parasites, information about the properties of different biotopes can be obtained. It is necessary to know the ecological characteristics of the parasite species, their geographical distribution, densities, and their relations with their host to determine the relationships between parasite faunas.

In this study, it was aimed to examine the Crustacean and Protozoan parasite fauna of fish species *C. macrostomum* (Heckel, 1843), *C. regium* (Heckel, 1843), *C. umbla* (Heckel, 1843), and *S. cephalus* (Linnaeus, 1758) living naturally in the Murat River. The study aims to detect Crustacean and Protozoan parasites in the mentioned fish species and contribute to the studies on fish parasites in their natural and breeding environments throughout the country. In addition, it is aimed to contribute to the precautions to be taken against the parasites to be detected in these fish that have commercial importance for Bingöl Province.

Material and Methods

Study Area and Sampling

The study was conducted between July 2017 and June 2019 in Murat River and Göynük Stream (Figure 1). The fish samples were caught by the various nets, and then the material was kept in the fish cage for the living stock in the catchment area. The fish caught were brought from the field to the laboratory with a transport tank and dissected within 24 hours by keeping them alive throughout the study with oxygen supplementation. The fish's total, fork, and standard-length measurements were recorded in millimeters (mm) and their weights in grams (g).

A total of 365 fish from the *C. macrostomum* (Heckel, 1843) (N=91, 130,88±28,61 mm), *C. umbla* (Heckel, 1843) (N=109, 133,67±26,25 mm), *C. regium* (Heckel, 1843) (N=80, 136,83±28,95 mm) and *S. cephalus* (Linnaeus, 1758) (N=85, 140,47±33,56 mm) fish species were examined, and 100 fish (27.4%) were infected with at least one Protozoan or Crustacean parasite.

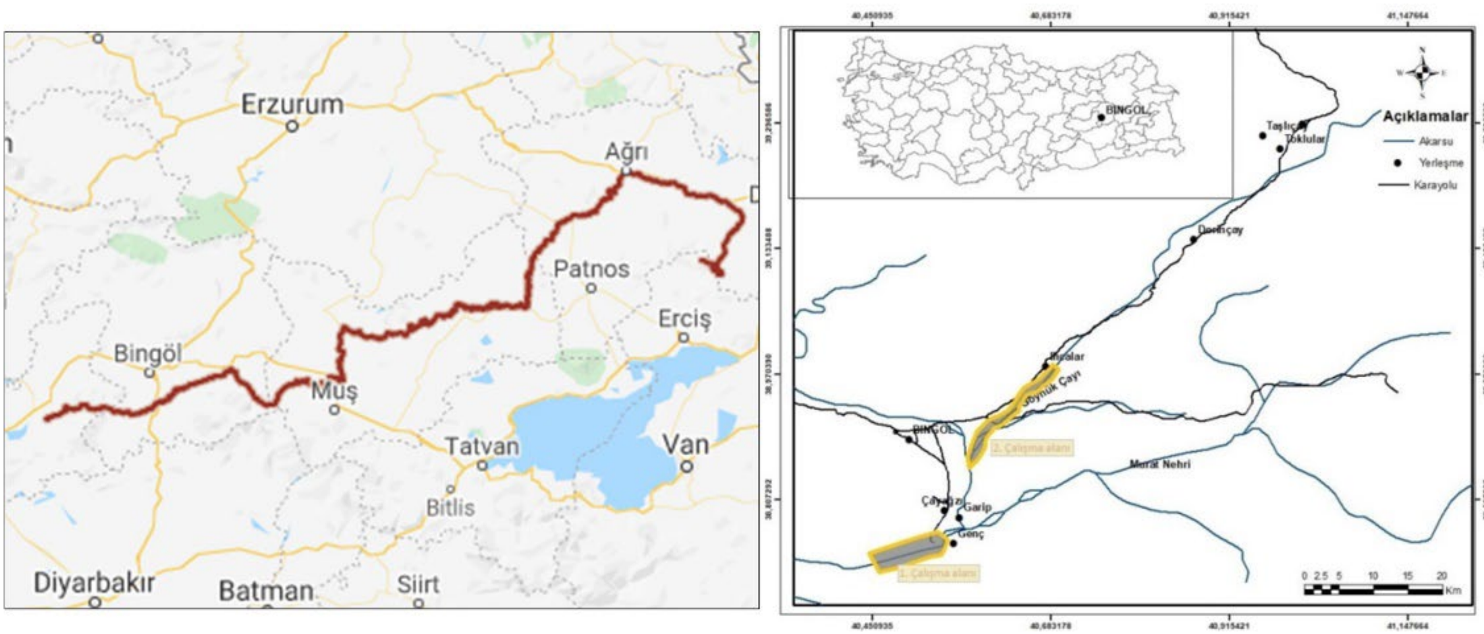

Figure 1. Murat River and the study area

Searching for Parasites

The skin, fins, nasal and oral cavities, gill lamellae were examined macroscopically. The gills were taken with forceps or scissors, placed in a petri dish containing physiological water, and examined under a stereomicroscope. The specimens were mounted unstained, photographed under the light microscope, and the number of parasites was recorded separately.

Statistical Analysis

The SPSS (version 25.0.0) program was used to calculate the prevalence, mean intensity, and mean rank of the parasites. The prevalence is the percentage of infested fish out of the total number of fish examined, the number of parasites per fish in the total number of infected fish is the mean intensity, and the mean rank is the average of the ranks for all observations within each sample. Kruskal-Wallis analysis was applied to the data to determine the significant differences between more than two groups (fish size or seasons, e.g.), and multiple comparison tests (Post Hoc analysis- Tamhane's T2) were applied determine which groups were different from each other.

The size of the fish; To facilitate the examination and to have sufficient information about the distribution, the number of groups was determined as four according to the classification rules, to best represent the groups for each fish species.

Results and Discussion

A total of four different parasite species were recorded on the examined fish, namely *I. multifiliis* and *Trichodina* sp. belonging to the phylum Ciliophora (Protozoan), *E. sieboldi*, and *L. pulchella* belonging to the phylum Arthropoda (Crustacean) (Table 1).

I. multifiliis Fouquet, 1876

Host fish: *C. macrostomum*, *C. regium, C. umbla, S. cephalus*

It is a large ciliated Protozoan with a prominent comma-shaped nucleus. The size of these ciliates usually ranges from 0.02 mm to about 1 mm, and these different sizes are used to distinguish between young and old. On the outer surface of the organism, which appears in color brownish under a light microscope, ciliates activate the protozoa and gently push them forward (Noga, 2010) (Figure 2).

The ciliate *I. multifiliis*, widely "Ich," is probably the most common parasite of freshwater teleosts with an extensive geographic range from the tropics to the temperate regions, north in Europe, to the Arctic Circle. The main factors in the current worldwide distribution of *I. multifiliis*, which infects freshwater teleosts, including cold water and tropical species, are its low host specificity, natural life cycle, and wide temperature tolerance (Matthews, 2005).

Table 1. Descriptive statistics of the parasites

Host Fish (N)	Parasite	Infected (n)	Prevalence (%)	Mean±SD	Min.-Max.	Total
C. macrostomum **(N=91)**	*E. sieboldi*	9	9.9	1.0±0.0	1	9
	I. multifiliis	7	7.7	4.6±5.3	1-15	32
	Total	15	16.5	2.7±3.9	1-15	41
C. regium **(N=80)**	*I. multifiliis*	14	17.5	14.2±3.6	1-42	199
	L. pulchella	6	7.5	2.5±1.3	1-9	15
	Trichodina sp.	2	2.5	1.0±0.0	1	2
	Total	17	21.3	12.7±12.8	1-42	216
C. umbla **(N=109)**	*L. pulchella*	41	37.6	1.3±0.1	1-3	54
	I. multifiliis	4	3.7	21.8±11.0	3-49	87
	Total	44	40.4	3.2±8.3	1-49	141
S. cephalus **(N=85)**	*L. pulchella*	16	18.8	1.1±0.1	1-2	18
	I. multifiliis	7	8.2	17.0±7.6	1-42	119
	E. sieboldi	3	3.5	1.3±0.3	1-2	4
	Trichodina sp.	1	1.2	1.0±0.0	1	1
	Total	24	28.2	5.9±12.6	1-42	142
Total (N=365)		100	27.4	5.4±10.4	1-49	540

N= Number, Mean±SD: Parasite/Infected fish±Standart Deviation

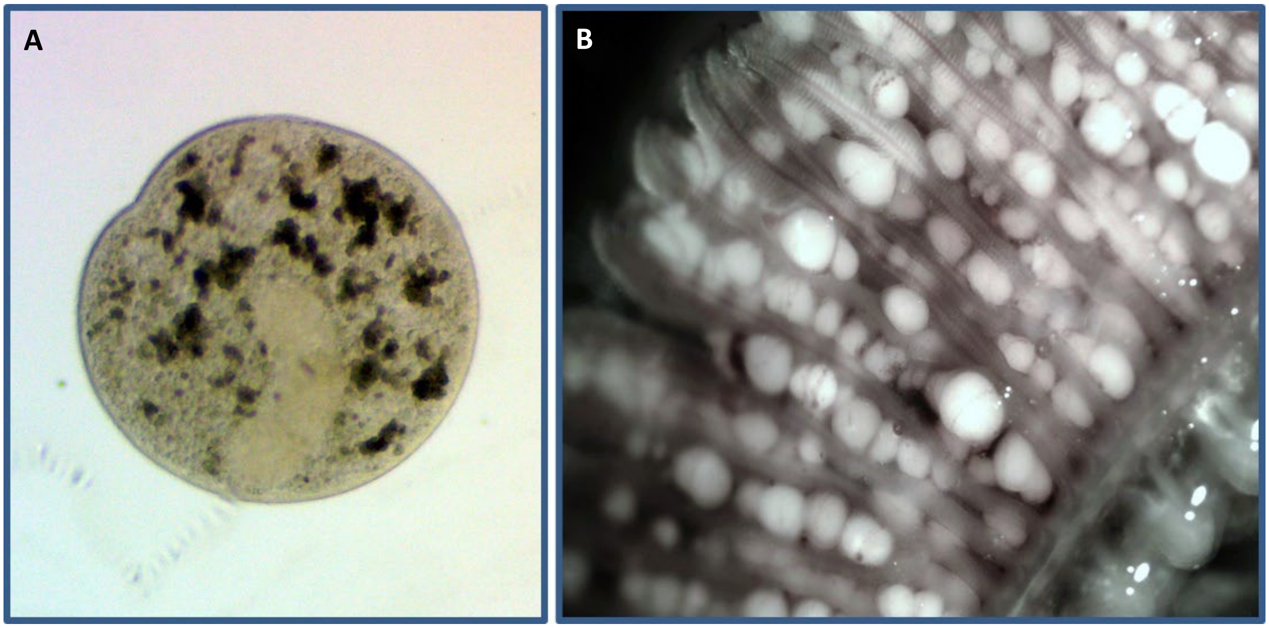

Figure 2. *I. multifiliis* A: Tomont stage B: Trophont stage

This parasite, which can live on the body, fins, and fish gills, causes White Spot Disease (Ich), one of the common and permanent diseases. Each white point is an encapsulated parasite. The parasite can be transmitted easily and quickly from one host to another or from an aquarium to another. Due to the natural life cycle of the parasite, it is not easy to control it when it enters a fish culture facility. When not controlled, a mortality rate of almost 100% on the host is possible. With careful treatment, the disease can be controlled. Due to the inflammation on the skin and gills of the host, mucus occurs in the areas where it is seen. The white speck that penetrates the tissue of the fish causes significant damage. As a result of the injuries, the fish become unable to control their movements and lose their swimming ability (Noga, 2010).

Host Distribution

The Kruskal-Wallis test indicates that there is no statistically significant difference in the *I. multifiliis* infestation levels of four different fish species [X^2(3, N=365) =4.392, p>0.05]. Descriptive statistics demonstrate that *I. multifiliis* is widespread on *C. regium* while concentrated in a small number of fish on *C. umbla* (Table 2).

Seasonal Distribution

The Kruskal-Wallis test states that there is no statistically significant difference in terms of seasonal infestation levels of *I. multifiliis* among the host fish [X^2 (3, N=365) =0.766, p> 0.05]. Prevalence reached high levels in autumn and mean intensity in spring (Table 3).

Distribution by Length

The Kruskal-Wallis test indicates that there is no statistically significant difference in *I. multifiliis* infestation levels between different sizes [X^2(3, N=365) =4.766, p>0.05] (Table 4). Although the test results do not evaluate the difference as acceptable (p>0.05), it is seen that there are variations between the host length groups. Mean intensity and mean ranks show that the larger the host size the higher the infestation rate. (Figure 3).

Table 2. Descriptive statistics of *I. multifiliis* and Kruskal-Wallis test results (Host type)

Host type	Infected (n)	Prev. (%)	Mean±SD	Mean rank	Test Statistics [a,b] *I. multifiliis*	
C. macrostomum **(N=91)**	7	7.7	4.6±2.0	10.6	Kruskal-Wallis H	4.392
C. regium **(N=80)**	14	17.5	14.2±3.6	18.6	df	3
C. umbla **(N=109)**	4	3.7	21.8±11.0	20.8	Asymp. Sig.	0.222
S. cephalus **(N=85)**	7	8.2	17.0±7.6	15.6	a. Kruskal Wallis Test	
Total (N=365)	32	8.8	13.7±15.3		b. Grouping Var.: Host type	

N= Number, Prev.: Prevalence, Mean±SD: Parasite/Infected fish±Standart Deviation

Table 3. Descriptive statistics of *I. multifiliis* and Kruskal-Wallis test results (Seasonal)

Seasons	Infected (n)	Prev. (%)	Mean±SD	Mean rank	Test Statistics [a,b] *I. multifiliis*	
Spring (N=108)	6	5.6	16.8±8.0	16.5	Kruskal-Wallis H	0.766
Summer (N=84)	8	9.5	12.8±6.2	15.6	df	3
Autumn (N=82)	10	12.2	14.1±4.6	18.5	Asymptotic Sig.(2-sided t.)	0.858
Winter (N=91)	8	8.8	11.6±4.7	14.9	a. Kruskal Wallis Test	
Total (N=365)	32	8.8	13.7±15.3		b. Grouping Var.: Seasons	

N= Number, Prev.: Prevalence, Mean±SD: Parasite/Infected fish±Standart Deviation

Table 4. Descriptive statistics of *I. multifiliis* and Kruskal-Wallis test results (By length)

Host length	Infected (n)	Prev. (%)	Mean±SD	Mean rank	Test Statistics [a,b] *I. multifiliis*	
1. Group (N=74)	4	5.4	9.5±6.9	13.5	Kruskal-Wallis H	0.846
2. Group (N=103)	12	11.7	13.5±5.0	15.9	df	3
3. Group (N=92)	14	15.2	14.6±4.0	18.0	Asymp. Sig.	0.838
4. Group (N=64)	2	3.1	16.0±15.0	15.5	a. Kruskal Wallis Test	
Total (N=365)	32	8.8	13.7±15.3		b. Grouping Var.: Host length	

N= Number, Prev.: Prevalence, Mean±SD: Parasite/Infected fish±Standart Deviation

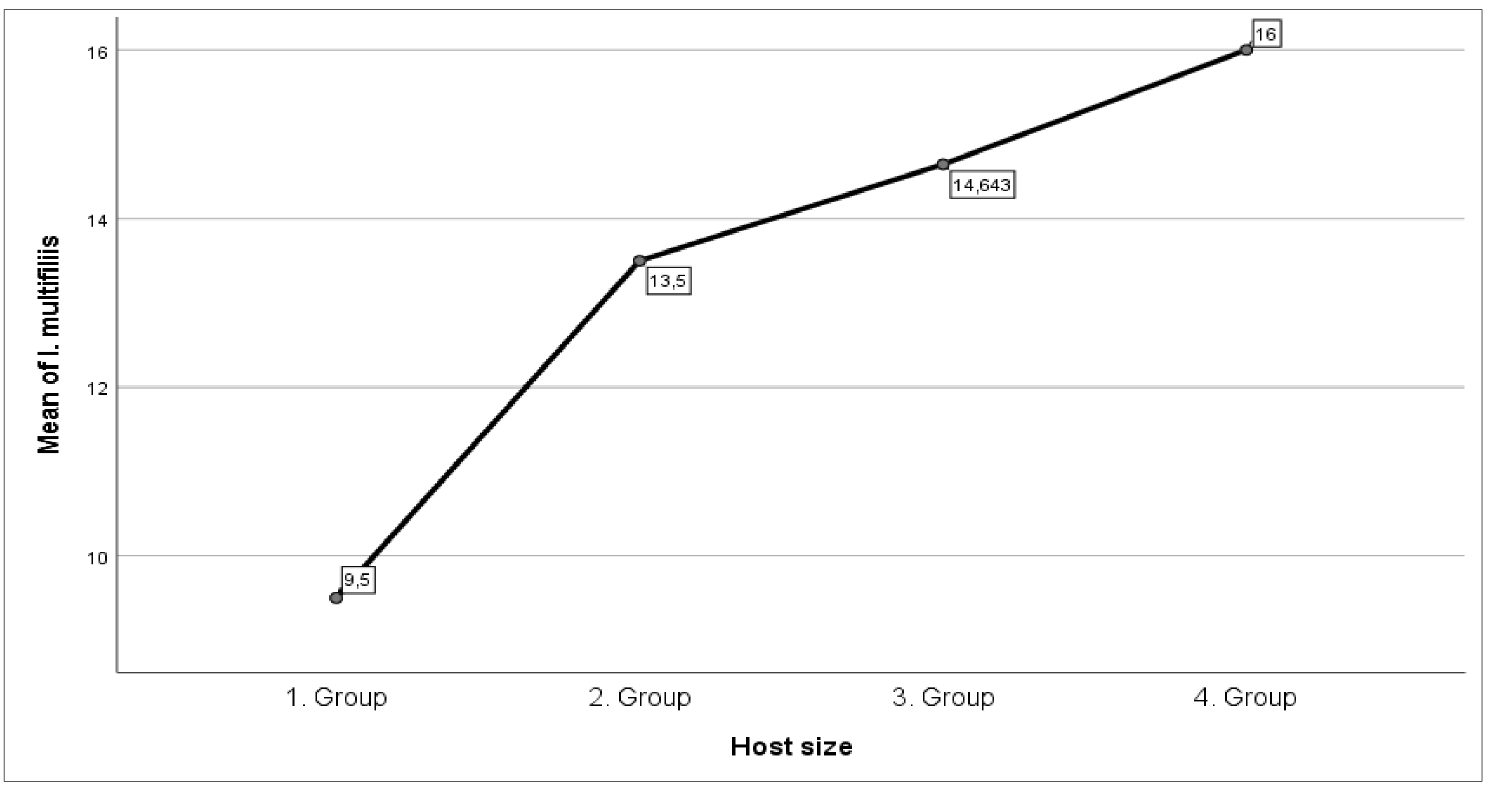

Figure 3. Mean intensity graph according to the host size of *I. multifiliis*

***Trichodina* sp.**

Host fish: *C. regium*, *S. cephalus*

Trichodinids are circular ciliates that can be disc-shaped or hemispherical. Cytostome (cell mouth) called the oral surface is on the surface of facing the host. There is a spiral of cilia leading to the cytostome and surrounding cells several rings of cilia, which are responsible for creating the absorbent for adhesion, the driving force for movement (Figure 4). In the taxonomy of trichodinids, the exact number, shape, and arrangement of cytoskeletal denticles are important for determining taxonomic relationships (Lom and Dyková, 1992).

Trichodinids, which can cause severe damage, especially in aquarium fish, are among the most common parasites of aquatic ecosystems and may prefer freshwater and marine fish as hosts (Çelik and Korun, 2018). Most trichodynides live ecto-commensal life as they feed on bacteria and only use their host fish as a substrate for attachment. However, certain species are primary pathogens because they can occur in sterile areas (e.g., urinary system) or provoke specific responses in host fish (e.g., *Tripartiella* on gills) (Lom and Dyková, 1992).

Statistics of Infestation with Trichodina sp.

It has been recorded on only three fish specimens from two different hosts. Since the data are not sufficient and only descriptive statistics are given in this section, statistical tests or comments are not made. (Table 1).

L. pulchella von Nordmann, 1832

Host fish: *C. regium*, *C. umbla*, *S. cephalus*

An adult female *L. pulchella* has an elongated body consisting of three separate parts: cephalothorax, thorax, and abdomen (Figure 5).

On the cephalothorax there are prominent antenna structures, eye spots and grabbing claws. There are intestinal structures in the thorax which have three segments, and a developed tail following the thorax. During the breeding times, a pair of eggs hatch from the third segment of the thorax and extend posteriorly on both sides of the tail (Figure 5-D). There are five pairs of legs in their bodies, which are quite distinct during the larval period, and it has seen that these legs do not develop in adults.

Host Distribution

According to the distribution of *L pulchella*, which is the dominant species among the parasites detected, there is no statistically significant difference in the infestation levels of three fish species among the hosts (Table 5) [$X^2(2, N=274) = 1.655$, $p>0.05$]. Since the parasite density is close to each other between hosts, it would be more accurate to interpret the prevalence from descriptive statistics than test results. Accordingly, it can be said that *L. pulchella* is more common on *C. umbla* than the other hosts.

Seasonal Distribution

The Kruskal-Wallis test indicates that there is no statistically significant difference in the infestation levels of *L.* pulchella according to the seasonal variations [X^2 (3, N = 274) = 2.583, $p>0.05$)]. *L. pulchella* reached the highest infestation rate in the Spring, which is the breeding season, and saw the lowest level in the Summer (Table 6).

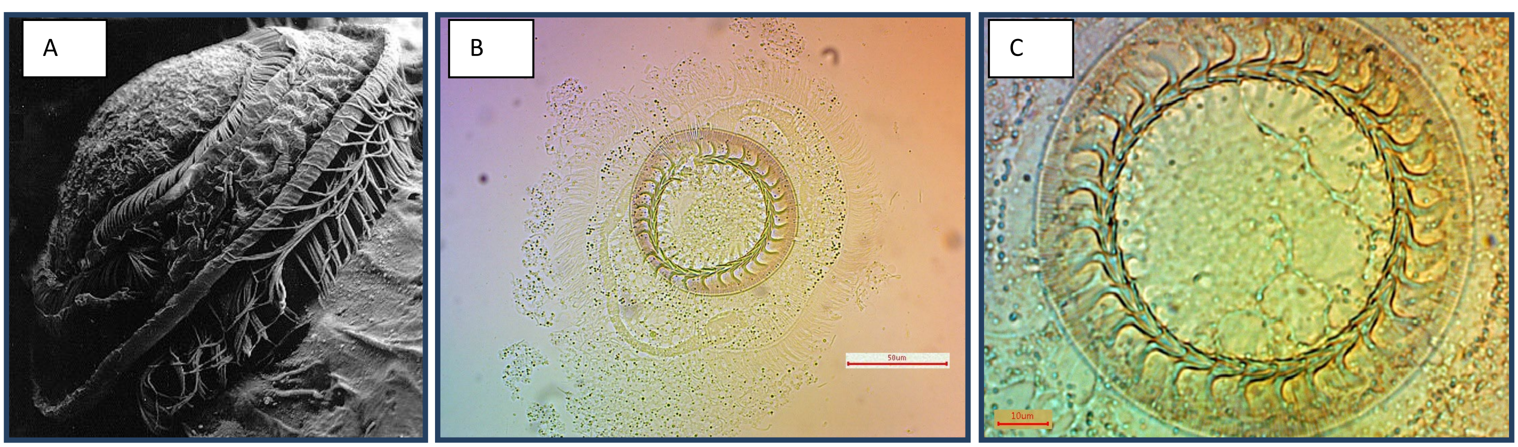

Figure 4. *Trichodina* sp. A: Scanning electron micrograph of a trichodinid ciliate attached to the gills of an Australian mullet (*Mugil cephalus*) (Dove, 2007), B-C: Image under a light microscope (Scale bars: 50 and 10 µm)

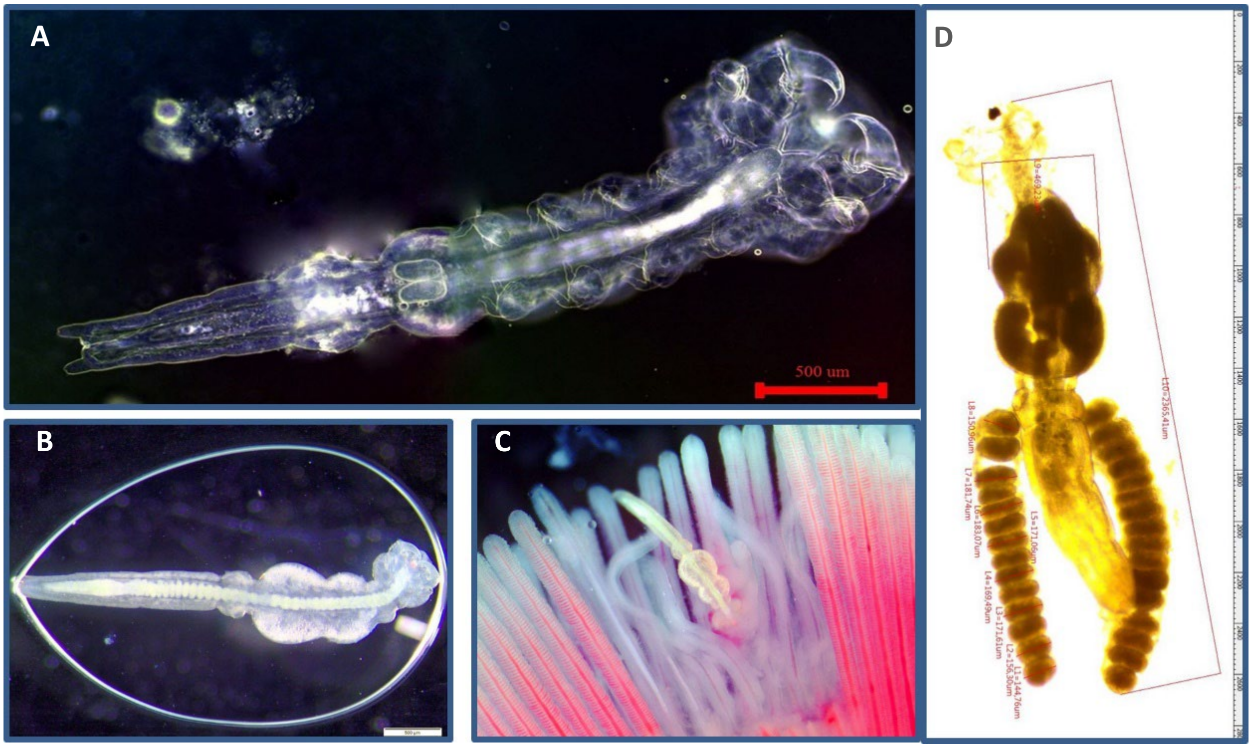

Figure 5. *L. pulchella* A: Juvenile form, B-C-D, Adult form

Table 5. Descriptive statistics of *L. pulchella* and Kruskal-Wallis test results (Host type)

Host type	Infected (n)	Prev. (%)	Mean±SD	Mean rank	Test Statistics a.b *L. pulchella*	
C. regium **(N=80)**	6	7.5	1.3±1.2	34.7	Kruskal-Wallis H	1.655
C. umbla **(N=109)**	41	37.6	1.3±0.9	33.1	df	2
S. cephalus **(N=85)**	16	18.8	1.1±0.9	28.3	Asymp. Sig.	0.437
					a. Kruskal Wallis Test	
Total (N=274)	63	23.0	1.3±0.5		b. Grouping Var.: Host type	

N= Number, Prev.: Prevalence, Mean±SD: Parasite/Infected fish±Standart Deviation

Table 6. Descriptive statistics of *L. pulchella* and Kruskal-Wallis test results (Seasonal)

Seasons	Infected (n)	Prev. (%)	Mean±SD	Mean rank	Test Statistics [a.b] *L. pulchella*	
Spring (N=88)	21	23.9	1.2±0.9	30.3	Kruskal-Wallis H	2.583
Summer (N=61)	7	11.5	1.4±0.2	37.6	df	3
Autumn (N=60)	18	30	1.2±0.9	29.6	Asymptotic Sig.	0.46
Winter (N=65)	17	26.2	1.4±0.2	34.4	a. Kruskal Wallis Test	
Total (N=274)	63	23	1.3±0.5		b. Grouping Var. Seasons	

N= Number, Prev.: Prevalence, Mean±SD: Parasite/Infected fish±Standart Deviation

Distribution by Length

The Kruskal-Wallis test indicates that there is no statistically significant difference in *L. pulchella* infestation levels among the host fish of different sizes [X^2 (3, N = 274) = 1.364, p> 0.05]. Mean and mean ranking show that as the size of the host increases, the number of infestations increases (Table 7).

***E. sieboldi* von Nordmann, 1832**

Host fish: *C. macrostomum*, *S. cephalus*

Blue colour pigment is its characteristic. The blue pigment on its posterior can be seen scattered even with the bared eyes. Blue pigment appears more clearly in young and female individuals (Figure 6). As the parasite grows old, the colour of the pigment becomes lighter and age determination can be made according to this colour darkness. One pair of swimming legs is located on each of the thoracic segments. Adult males are like females, but they are much shorter and thinner.

E. sieboldi, a Crustacean ectoparasite, is known to be a common gill parasite on Cyprinid fish. Only female individuals of *E. sieboldi*, are parasitic and sometimes show a cosmopolitan distribution as a parasite in much freshwater fish and sometimes in free form.

Statistics of Infestation with E. sieboldi

It has been identified as 13 on 12 fish in two different hosts. Since the data are not sufficient, only descriptive statistics are given in this section, statistical tests or any comments are not made (Table 1)

Table 7. Descriptive statistics of *L. pulchella* and Kruskal-Wallis test results (By length)

Host length	Infected (n)	Prev. (%)	Mean ±SD	Mean rank	Test Statistics [a,b] *L. pulchella*	
1. Group (N=57)	11	19.3	1.3±0.2	30.7	Kruskal-Wallis H	1.364
2. Group (N=92)	22	23.9	1.3±0.1	33.2	df	3
3. Group (N=81)	16	19.8	1.3±0.1	34.0	Asymp. Sig.	0.714
4. Group (N=44)	14	31.8	1.4±0.2	28.9	a. Kruskal Wallis Test	
Total (N=274)	63	23.0	1.1±0.9		b. Grouping Var.: *Host length*	

N= Number, Prev.: Prevalence, Mean±SD: Parasite/Infected fish±Standart Deviation

Figure 6. *E. sieboldi* adult female

Conclusion

This study was conducted between July 2017 and June 2019 in Murat River and Göynük Stream. A total of 365 fish from the *C. macrostomum*, *C. umbla*, *C. regium*, and *S. cephalus* fish species were examined, and 100 fish (27.4%) were infected with at least one Protozoan or Crustacean parasite. It was observed that there was a statistically significant difference in total parasitization levels of the two fish species (*C. regium* and *C. macrostomum* Tamhane's T2 $p<0.05$). The rate of infection with any parasite reached the highest level on *C. umbla* (40.4%), while it was followed by *S. cephalus* (28.2%), *C. regium* (21.3%), and *C. macrostomum* (16.5%), respectively. General infestation levels for all fish species have taken values close to each other in all seasons, and there was no statistically significant difference between the infestation amounts ($p>0.05$). It was determined that there was no statistically significant difference in total parasite infestation levels among host fish of different sizes ($p>0.05$); however, as the host size increased, parasite infrapopulations also increased. In this section, the detected parasites are discussed separately for each parasite species, first Protozoan and then Crustacean, within the framework of the effects and distributions reported in the previous studies.

***I. multifiliis* Fouquet, 1876**

Host: *C. macrostomum*, *C. regium, C. umbla, S. cephalus*

I. multifiliis was reported from skin and gills of *A. marmid* from Greater Zab river and Darbandikhan lake, *A. grypus* (reported as *B. grypus*), and *C. trutta* from Darbandikhan lake, *C. umbla* (reported as *V. umbla*) from Lesser Zab river, *Carasobarbus luteus* (reported as *Barbus luteus*) and *C. macrostomum* from Erbil's fish market and Greater Zab river, *C. luteus* from Darbandikhan lake, skin, fins, buccal cavity and gills of *C. regium* from Greater Zab river, *C. carpio* from Lesser Zab river, gills of *H. molitrix* from Darbandikhan lake, skin and gills of *L. barbulus* (reported as *Barbus barbulus*) from Lesser Zab and Greater Zab rivers, skin and gills of *L. esocinus* from Darbandikhan lake, *M. mastacembelus* from Darbandikhan lake, skin, fins and gills of *S. triostegus* from Greater Zab river, skin and gills of *S. lepidus* from Darbandikhan lake. A total of 35 fish host species are known for *I. multifiliis* in Iraq (Mhaisen and Abdullah, 2017).

Balta et al. (2008) found *Trichodina* sp. and *I. multifiliis* on *Oncorhynchus mykiss, Salvelinus fontinalis, Salmo trutta* fario. Kayış et al. (2018) reported at low densities *Trichodina* sp. on *Alburnoides fasciatus*, *Barbus artvinica*, *Capoeta banarescui*, *Capoeta ekmekciae*, *Capoeta sieboldii*, *Squalis orientalis*, and *I. multifiliis* on *C. banarescui*, *A. fasciatus* and *S. oriantalis*. Bingöl (2018) reported *Trichodina* sp. and *I. multifiliis* on *Oncorhynchus mykiss* and *Salmo coruhensis*. As a result, *I. multifiliis* reported for the first time on *S. cephalus.*

Especially the presence of *I. multifiliis*, which is common in aquaculture and is relatively more challenging to treat than other Protozoan parasites, carries a risk in the future for aquaculture activities in the region.

***Trichodina* sp.**

Host: *C. regium*, *S. cephalus*

There was no report on trichodinid species until 1998 in Türkiye. In 1998, *T. acuta*, *T. mutablis*, and *T. nigra* were reported from natural and cultured fish for the first time. Various parasite species infected a total of 204 out of 850 fish species in Türkiye, and only 31 fish species were found to be infested with 33 trichodinid parasites. Considering the total number of fish species in the Turkish fauna and the number of trichodinids identified, more extensive studies on unexamined fish species are required to obtain a complete picture in all Turkish waters (Özer and Öztürk, 2015).

Although the Protozoan mentioned above parasites reported in the study were reported from both aquaculture systems and aquarium fish (Kayış et al. 2013), no severe cases were encountered in the literature when considered in terms of mortality. In addition, since previous studies were checked, it can be said that *Trichodina* sp is a new record for these cyprinid fish (*C. regium* and *S. cephalus*).

***E. sieboldi* von Nordmann, 1832**

Host: *C. macrostomum, S. cephalus*

The first studies on *E. sieboldi* in Türkiye were the studies of Sarıeyyüpoğlu and Sağlam (1991). *E. sieboldi* has been reported on *C. carpio* from Dalyan Lagoon (Aydoğdu et al. 2001), *Platichthyes flesus* from Sarıkum Lagoon (Sinop) (Öztürk and Özer, 2008), *Tinca tinca* from Sapanca Lake (Akbeniz and Soylu, 2008), *Neogobius fluviatis*, *Proterorhinus marmoratus*, *Pomatoschistus marmoratus* from Bafra Fish Lakes (Çam, 2012), *Acathobrama marmid* from Göynük Stream (Koyun et al. 2019), *Barbus lacerta* (Koyun et al. 2015) and *Alburnus mossulensis* from Murat River (Tunç and Koyun, 2018).

In this study, 13 fish were detected in a total of 12 fish from two different hosts (*C. macrostomum-S. cephalus*). When studies in Türkiye and abroad were investigated, it was seen that *E. sieboldi* was not previously reported for neither *C. macrostomum* nor *S. cephalus*. In this study, *C. macrostomum* and *S. cephalus* were reported as new host records for *E. sieboldi*.

L. pulchella **von Nordmann, 1832**

Host: *C. regium, C. umbla, S. cephalus*

The genus *Lamproglena*, which lives on freshwater fish families such as Cyprinidae, Cichlidae, Clariidae, and Channidae, contains more than 40 species. *L. pulchella* has previously been reported from South America, Europe, Asia, and Africa. The first record of *L. pulchella* was reported in *Chondrostoma nasus* from Romania by Angelescu (1974) (Stavrescu-Bedivan et al. 2008).

In Iraq, *L. pulchella* was firstly reported from gills of both *C. regium* and *C. trutta* (reported as *V. trutta*) from Tigris River at Mosul city. So far, *L. pulchella* has 20 fish host species in Iraq. *L. pulchella* was reported from gills of *C. regium* living in Lesser Zab River, *C. damascina* (reported as *B. belayewi*) *C. umbla* (reported as *V. umbla*), *C. luteus* (reported as *B. luteus*), *C. regium, G. rufa, L. vorax* (reported as *A. vorax*), *L. barbulus* (reported as *B. barbulus*), *L. esocinus* (reported as *B. esocinus*), *S. cephalus* (reported as *L. cephalus*), *S. lepidus* (reported as *L. lepidus*) and *S. spurius* (reported as *L. spurius*) living in Greater Zab River, *C. damascina* (reported as *B. belayewi*), *C. umbla* (reported as *V. umbla*), *C. macrostomum, L. barbulus* (reported as *B. barbulus*), *L. kersin* (reported as *B. kersin*) and *S. lepidus* (reported as *L. lepidus*) living in Bahdinan River, *C. regium* living in Bahdinan Lake, *C. luteus* (reported as *B. luteus*) living in Darbandikhan Lake, *L. esocinus* (reported as *B. esocinus)* and *L. xanthopterus* (reported as *B. xanthopterus*) living in Dokan Lake (Mhaisen and Abdullah, 2017).

In Türkiye, *L. pulchella* was reported from gills of *S. erythrophthalmus* from Sapanca Lake (Soylu, 2012) (Kuş and Soylu, 2013), *C.* trutta and *C. regium* from Keban Dam Lake (Sağlam, 1998), *C. trutta* from Balıklıgöl (Şanlıurfa) (Öktener et al. 2008), and *C. trutta* (Koyun et al. 2019), *B. lacerta* (Koyun et al. 2015), *A. mossulensis* (Tunç and Koyun, 2018) from Göynük Stream and Murat River (Bingöl).

In this study, *L. pulchella* was detected on *C. regium* (7.5%), *C. umbla* (37.6%), and *S. cephalus* (18.8%). As seen in previous studies and this study, this parasite appears to be common among Cyprinid fish species.

Compliance with Ethical Standard

Conflict of interests: The authors declare that for this article they have no actual, potential or perceived conflict of interests.

Ethics committee approval: The use of fish was approved by Bingöl University Animal Experimentation Ethics Committee (Bingöl, Türkiye) 08.11.2021-E.33221.

Funding disclosure: This study was supported by the project numbered BAP-FEF.2017.00.018, Bingöl University Scientific Research Projects Coordination Unit.

Acknowledgments: -

Disclosure: -

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