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Occurrence of endo and ectoparasites on *Capoeta trutta* (Heckel, 1843) and *Acanthobrama marmid* Heckel, 1843 (Cypriniformes: Cyprininae) inhabiting in Göynük Stream Eastern Anatolia

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Abstract. Here, the metazoan parasites of *Capoeta trutta* (Heckel, 1843) and *Acanthobrama marmid* Heckel, 1843 fishes in the Göynük stream were sampled between July 2011 and June 2012. During the study, 37 *C. trutta* and 44 *A. marmid* were examined. Eight different parasite species were found in *C. trutta*: *Dactylogyrus crivellius, Dactylogyrus lenkorani, Dactylogyrus pulcher, Dogielius mokhayeri, Gyrodactylus* sp. 1 (Monogenea), *Rhabdochona denudata* (Nematoda), *Neoechinorhynchus zabensis* (Acanthocephala) and *Lamproglena pulchella* (Copepoda). Five different parasite species were found in *A. marmid*: *Dactylogyrus elegantis, Gyrodactylus* sp. 2, *Paradiplozoon megan* (Monogenea), *Caryophyllaeus laticeps* (Cestoda) and *Ergasilus sieboldi* (Copepoda). Infection values of parasite species were calculated. According to the results, it determined that *N. zabensis* (43.24 %) is dominant species in *C. trutta* and *D. elegantis* (70.45 %) is dominant species on *A. marmid*. The parasites were found on *C. trutta*, *D. crivellius* and *D. mokhayeri* are the first records for parasite fauna in Turkish freshwater fishes.

Keywords: *Capoeta trutta*, *Acanthobrama marmid*, Monogenea, Nematoda, Acanthocephala, Copepoda, Cestoda

Introduction

Besides being a marker of biological events, creatures living in nature as parasites, also give some ideas about the environment such as nutrition and immigration of the host they are in. By identifying intermediate host and last host conditions in the life cycle of the parasites, it can be learned about the characteristics of different biotopes (Hanzelova & Zitnan 1985, Barber & Poulin 2002). To determine the relationships between parasitic faunas, it should be known the ecological characteristics of parasite species, their geographical distribution, their intensity and their relationship with their host (Koyun 2011a).

C. trutta and *A. marmid* are two of the most common and widely distributed cyprinid species, and *C. trutta* has been reported from Tigris, Euphrates, Murat, Orontes, Batman, Euphrates Rivers, (Karasu and Birecik) Amik and Seyhan Dam Lakes, Syria (Aleppo), Iran and Iraq (Geldiay & Balık 2007, Kalkan 2008, Jouladeh-Roudbar et al. 2015, Kaya et al. 2016), and also studies about *C. trutta* and *A. marmid* parasites from all over the world, given in Table 3-4.

The present study is the first for the parasite fauna of *C. trutta* and *A. marmid* in Göynük Stream (Bingöl, Turkey). Therefore, the purposes of this study were to determine the helminth parasite fauna of *C. trutta* and *A. marmid* inhabiting naturally in Göynük Stream and to investigate the prevalence and mean intensity of parasite species on these two host fishes.

Materials and Methods

The study was conducted in Göynük stream (Bingöl). The fish were sampled with fishing nets at seasonal intervals from July 2011 to June 2012. And the captured fish immediately transferred to the research laboratory and kept in an aquarium. Examined fishes were sacrificed, and capture places, date, weight (g), length (mm), and sex were recorded. Their skins, fins, nasal cavities, gill lamellae and mouth gaps were grossly examined within 24 hours for ectoparasites. The external parasites monogeneans and copepods were photographed under a light microscope (Olympus SZ 51). For endoparasites, the internal organs were examined macroscopically before removing, then digestive and excretory duct (esophagus, stomach, and intestines) were taken to a petri dish containing 0.7% saline water. Monogenea, Copepoda and Nematoda samples were prepared without any dyeing process but Cestoda and Acanthocephala samples were stained with the acetocarmin. The parasite specimens were identified using the reference keys of Bykhovskaya & Pavlovskaya (1962), Amin et al. (2003) and Pugachev et al. (2009).

Results

During the study 37 *C. trutta* and 44 *A. marmid* specimens were examined and thirteen different parasite species were found on the host fish. Eight different parasite species were found in *C. trutta*: *D. crivellius* (Figs 1-2), *D. lenkorani* (Figs 3-4), *D. pulcher* (Figs 5-6), *D. mokhayeri* (Figs 7-8), *Gyrodactylus* sp. 1 (Figs 9-10) (Monogenea), *R. denudata* (Fig. 19) (Nematoda), *N. zabensis* (Figs 16-17-18) (Acanthocephala) and *L. pulchella* (Figs 21-22) (Copepoda). Five different parasite species were found in *A. marmid*: *D. elegantis* (Figs 13-14-15), *Gyrodactylus* sp. 2 (Figs 11-12), *P. megan* (Monogenea) (Figs 23-24), *C. laticeps* (Cestoda) (Fig. 25) and *E. sieboldi* (Copepoda) (Fig. 20). There are several studies for *C. trutta* and *A. marmid* in Turkey and nearby regions (Table 3-4).

In this study, infection with *D. elegantis, D. mokhayeri,* and *N. zabensis* were recorded throughout the year. *D. elegantis* was found on *A. marmid* is the dominant species with an infection prevalence of 70.45%, and *N. zabensis* was found in *C. trutta* is the second dominant species with an infection prevalence of 43.24%. According to the results, it was determined that *N. zabensis* (43.24 %) was dominant species in *C. trutta* and *D. elegantis* (70.45 %) was dominant species in *A. marmid*.

The infection values of the aforementioned parasites varied from season to season. The maximum prevalence of *D. elegantis* was recorded in the spring (90.91 %) and minimum in the autumn (40 %). On the contrary, the prevalence of *N. zabensis* was maximum in the autumn (75%) and minimum

Table 1. The prevalence, mean intensity and maximum intensity of helminthes in/on *C. trutta.*

	Seasons				
	All year	Spring	Summer	Autumn	Winter
The number of examined fish	37	9	16	4	8
D. crivellius					
Prevalence (%)	18.92	-	25.00	-	37.50
Mean Intensity	20.14	-	22.00	-	17.67
Max. Intensity	62	-	62	-	20
The number of infected fishes	7	-	4	-	3
D. lenkorani					
Prevalence (%)	18.92	-	31.25	50.00	-
Mean Intensity	21.14	-	22.20	18.50	-
Max. Intensity	43	-	43	21	-
The number of infected fishes	7	-	5	2	-
D. pulcher					
Prevalence (%)	13.51	22.22	6.25	50.00	-
Mean Intensity	4.40	1.00	2.00	9.00	-
Max. Intensity	13	1	2	13	-
The number of infected fishes	5	2	1	2	-
D. mokhayeri					
Prevalence (%)	35.14	11.11	37.5	75	37.5
Mean Intensity	7.85	21.00	4.67	8.67	9.00
Max. Intensity	21	21	9	12	15
The number of infected fishes	13	1	6	3	3
Gyrodactylus sp. 1					
Prevalence (%)	18.92	-	-	50	62.5
Mean Intensity	18.71	-	-	3	25
Max. Intensity	62	-	-	4	62
The number of infected fishes	7	-	-	2	5
R. denudata					
Prevalence (%)	5.41	11.11	6.25	-	-
Mean Intensity	2.50	3.00	2.00	-	-
Max. Intensity	3	3	2	-	-
The number of infected fishes	2	1	1	-	-
N. zabensis					
Prevalence (%)	43.24	22.22	37.50	75.00	62.50
Mean Intensity	14.56	2.00	24.50	12.33	9.00
Max. Intensity	112	3	112	24	20
The number of infected fishes	16	2	6	3	5
L. pulchella					
Prevalence (%)	18.92	11.11	37.50	-	-
Mean Intensity	1.57	1.00	1.66	-	-
Max. Intensity	2	1	2	-	-
The number of infected fishes	7	1	6	-	-
L. pulchella (advanced larval form)					
Prevalence (%)	24.32	33.33	25.00	-	-
Mean Intensity	3.00	1.00	5.50	-	-
Max. Intensity	10	1	10	-	-
The number of infected fishes	7	3	4	-	-

in the spring (22.22 %), but mean intensity was maximum in the summer (24.50). The reason for this estimate is the difference between numbers of examined and infected fish caught throughout the study. The last parasite recorded throughout the year, *D. mokhayeri*, was maximum in the autumn (75 %) and minimum in the spring (11.11 %).

The other parasite species were recorded at least in two seasons. *D. pulcher, Gyrodactylus* sp. 2 and *P. megan* were recorded in three seasons. *D. crivellius*, *D. lenkorani*, *Gyrodactylus* sp. 1, *R. denudata*, *L. pulchella*, *C. laticeps* and *E. sieboldi* were recorded in two seasons. All of the parasite species were found in the summer, excluding *Gyrodactylus* sp. 1. This parasite was found in autumn and winter.

Discussion

All fishes can be infected with an in particular diverse array of metazoan or other parasites at all stages of their lifespan (Anderson 2000). The parasite prevalence and intensity depend on many factors like its life cycle, host and its feeding habits and the physical factors of water where the fish lives

Table 2. The prevalence, mean intensity and maximum intensity of helminthes in/on *A. marmid*.

	Seasons				
	All year	Spring	Summer	Autumn	Winter
The number of examined fish	44	11	18	5	10
D. elegantis					
Prevalence (%)	70.45	90.91	55.56	40.00	90.00
Mean Intensity	7.97	9.60	7.90	5.50	6.78
Max. Intensity	27	23	27	6	20
The number of infected fishes	31	10	10	2	9
Gyrodactylus sp. 2					
Prevalence (%)	40.91	81.82	38.89	-	20.00
Mean Intensity	9.67	10.33	10.43	-	4.00
Max. Intensity	53	25	53	-	4
The number of infected fishes	18	9	7	-	2
P. megan					
Prevalence (%)	27.27	27.27	27.78	-	40.00
Mean Intensity	2.67	3.67	2.40	-	2.25
Max. Intensity	5	5	5	-	5
The number of infected fishes	12	3	5	-	4
C. laticeps					
Prevalence (%)	4.54	-	5.55	-	10.00
Mean Intensity	1.50	-	1.00	-	2.00
Max. Intensity	2	-	1	-	2
The number of infected fishes	2	-	1	-	1
E. sieboldi					
Prevalence (%)	20.45	-	22.22	100.00	-
Mean Intensity	3.22	-	2.25	4.00	-
Max. Intensity	8	-	5	8	-
The number of infected fishes	9	-	4	5	-

Figure 1. *Dactylogyrus crivellius*, hooks

Figure 2. *Dactylogyrus crivellius*, copulatory organ

Figure 3. *Dactylogyrus lenkorani*, hooks

Figure 4. *Dactylogyrus lenkorani*, copulatory organ

(Zaidi & Khan 1976).

There are some similar studies carried out in the Murat River in Turkey (Koyun 2011a-b-c, Koyun et al. 2015, Tunç & Koyun 2018). Aslan (2009) reported *R. denudata* from *Capoeta capoeta* and *Barbus plebejus*, *Neoechinorhynchus* sp. from *Capoeta barroisi*, and *Allocreadium isoporum* from *B. plebejus*. Koyun (2011a) has identified five monogenean species on four different fish species living in Murat River. These are *D. elegantis* and *D. vistulae* on *Chondrostoma regium*, *D. elegantis*, *D. vistulae* and *D. prostae* on *Squalis cephalus*, *D. alatus* on *Alburnus heckeli*, and *D. rectotrabus* on *Garra rufa*. Koyun (2011b) reported *Tracheliastes polycolpus* and *Piscicola geometra* on *Capo-*

Figure 5. *Dactylogyrus pulcher*, hooks

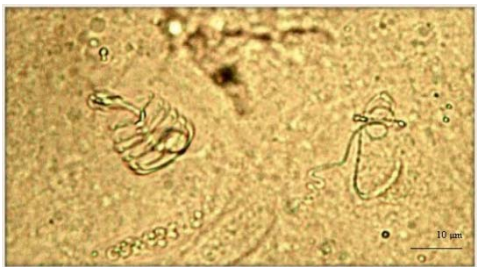

Figure 6. *Dactylogyrus pulcher*, copulatory organ

Figure 7. *Dogielius mokhayeri*, hooks

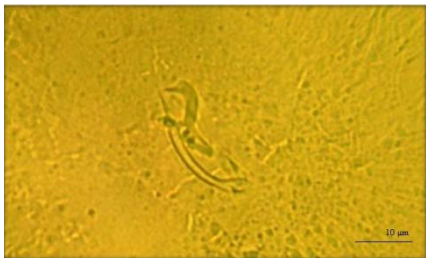

Figure 8. *Dogielius mokhayeri*, copulatory organ

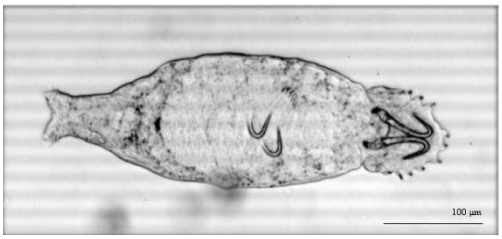

Figure 9. *Gyrodactylus* sp. 1, total view

Figure 10. *Gyrodactylus* sp. 1, hooks

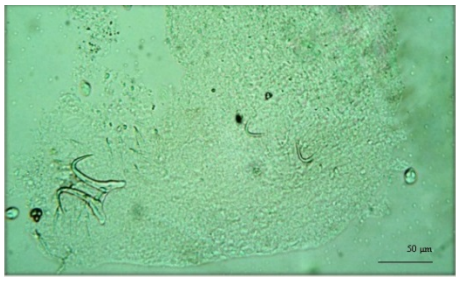

Figure 11. *Gyrodactylus* sp. 2, total view

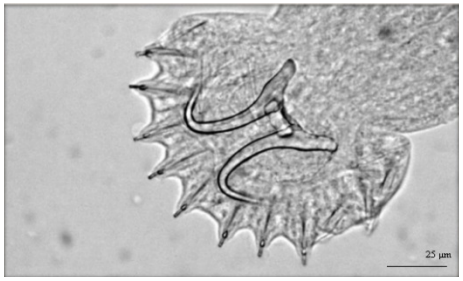

Figure 12. *Gyrodactylus* sp. 2, hooks

Figure 13. *Dactylogyrus elegantis*, total view

Figure 14. *Dactylogyrus elegantis*, hooks

Figure 15. *Dactylogyrus elegantis*, copulatory organ

Figure 16. *Neoechinorhynchus zabensis*, proboscis

Figure 17. *Neoechinorhynchus zabensis* (female)

Figure 18. *Neoechinorhynchus zabensis* (male)

Figure 19. *Rhabdochona denudata* (mouth)

Figure 20. *Ergasilus sieboldi*

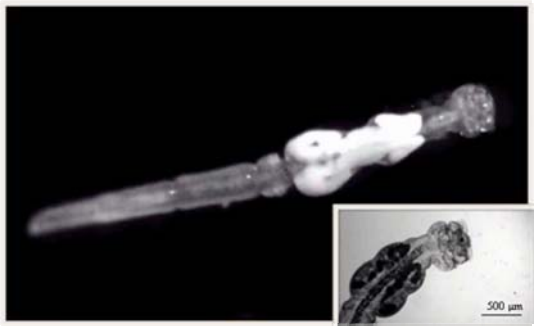

Figure 21. *Lamproglena pulchella*

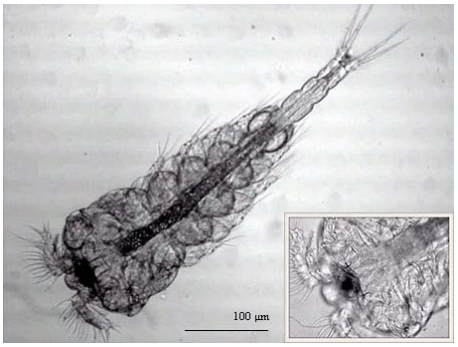

Figure 22. *Lamproglena pulchella* (advanced larval form)

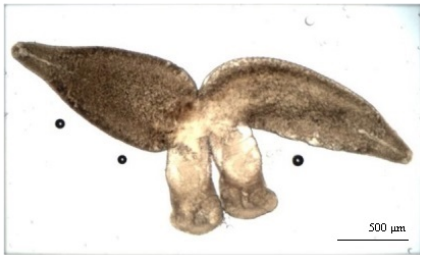

Figure 23. *Paradiplozoon megan*

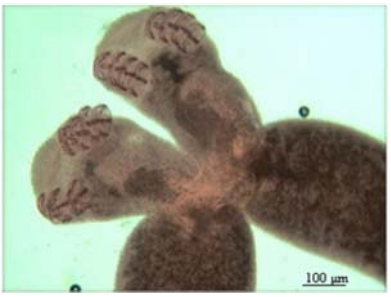

Figure 24. *Paradiplozoon megan*

Figure 25. *Caryophyllaeus laticeps*

eta umbla in another work from the Murat River. Koyun (2011c, 2012) also identified *D. lenkorani*, *Dogielius forceps*, and *N. zabensis* in *Capoeta umbla* from the Murat River. In his another study carried out in the Göynük Stream (Bingöl), *Paradiplozoon bingolensis* was reported as a new species on *Garra rufa* (Civáňová et al. 2013).

There are similarities between the study we have done and the previous studies carried out in the Murat River in terms of species identification. For example; *D. elegantis*, *D. lenkorani*, *N. zabensis* and *R. denudata* were found to be as

Table 3. The helminth studies for *C. trutta* from all over the world

Helminths	Locations	Literatures
G. markevitschi	Tigris River, Iraq	Abdul-Ameer (1989)
E. sieboldi, A. foliaceus	Keban Dam Lake, Turkey	Sarıeyyüpoğlu & Sağlam (1991)
Myxobulus cyprinicola, Oodinium pillularis, D. sphyrna, Diclybothrium homulatum L. pulchella, E. sieboldi, T. polycolpus	Keban Dam Lake, Turkey	Sağlam (1992)
D. pulcher	Dez River, Iran	Molnár & Jalali (1992)
D. microcirrus	Dez River, Iran	Gussev et al. (1993)
M. molnari, M. mokhayeri	Karun River, Ahvaz, Iran	Baska & Masoumian (1996)
L. pulchella	Keban Dam Lake, Turkey	Sağlam (1998)
Neoechinorhynchus sp. *Rhabdocona* sp.	Khorramabad River, Iran	Peyghan et al. (2001)
N. rutili	Keban Dam Lake, Koçkale, Turkey	Sağlam & Sarıeyyüpoğlu (2002)
N. zabensis	Greater and Lesser Zab Rivers, Iraq	Amin et al. (2003)
B. gowkongensis N. rutili	Keban Dam Lake, Turkey	Dörücü & İspir (2005)
N. rutili	Keban Dam Lake, Turkey	Dörücü et al. (2008)
Lernaea sp., *T. polycolpus*	Iran Caspian and Tigris Region, Azerbaijan Province	Barzegar & Jalali (2009)
Rhabdocona tigridis	Tigris River Basin, North Iraq	Moravec et al. (2009)
N. rutile, Diplostomum sp.	Karakaya Dam Lake, Turkey	Barata (2012)
N. zabensis	Murat River, TurkeyDez River, Iran	Koyun (2012) Oğuz et al. (2012)
G. elegans	Lesser Zab River, Iraq	Nasraddin (2013)
N. rutile, Diplostomum sp.	Keban Dam Lake, Pertek, Turkey	Kavak & Şeker (2017)

Table 4. The helminth studies for *A. marmid* from all over the world.

Helminths	Locations	Literatures
Myxobolus pfeifferi E. sieboldi, N.rutili	Zap River, North Iraq	Rashid et al. (1989)
Gyrodactylus elegans	Tigris River, Iraq	Mhaisen et al. (1995)
Myxidium rhodei	Tigris River, Neinava, Iraq	Al-Khateeb et al. (1997)
Diplostomum sp.	Keban Dam Lake, Turkey	Dörücü et al. (2002)
L. intestinalis, Diplostomum sp.	Keban Dam Lake, Turkey	Dörücü & İspir (2005)
D. distinguendus	Assad Lake, Syria	Al-Samman et al. (2006)
Gyrodactylus sp.	Basrah, Iran	Al-Janae'e (2010)
Tetraonchus sp., *D. paradoxum*	Dörtyol, Hatay, Turkey	Yıldırım et al. (2010)
L. intestinalis, N. rutile, Diplostomum sp.	Karakaya Dam Lake, Turkey	Barata (2012)
L. intestinalis, N. rutile, Diplostomum sp.	Keban Dam Lake, Turkey	Kavak & Şeker (2017)

common species for the Cyprinidae fish (Koyun 2011a, Koyun et al. 2015). On the other hand, it has been found that these parasites are not selective in host preference because of detecting on different fish species in different regions. Although the parasites we detected in both *C. trutta* and *A. marmid* were different from the parasitic studies in the Keban Basin, it was seen that the studies from Iranian region of the Euphrates River system overlaps with the data we have obtained. These differences are because of the reasons such as the chemical properties of the water and the host factor as well as the reasons for the techniques used. The data on the prevalence, the mean intensity, and the maximum intensity with seasonal distribution of all the helminth species in *C. trutta* and *A. marmid* are given in Table 1-2.

During the study, although the species of *C. trutta* and *A. marmid* were caught from the same stations, no common parasites were found. For example, despite the occurrence of *Dactylogyrus* in two fish, none of the *Dactylogyrus* species found in *C. trutta* was found in *A. marmid*. Likewise; *A. marmid* has *D. elegantis*, while *C. trutta* has not. In addition, *Gyrodactylus* was encountered on both hosts, but it was seen that each one was different in the diagnostic.

This suggests that the parasites may be species with host selectivity. The identified parasite species *D. crivellius* and *D. mokhayeri* are the first records for Turkey freshwater fish parasite fauna. Studies occurrence of parasites in fishes in different habitats are important for understanding the geographical distribution and relationships with their hosts. Additional studies are needed to examine different populations of freshwater and marine fishes for this purpose in future.

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