



Occurrence of *Dactylogyrus* species (Platyhelminths, Monogenean) on Cyprinids in Almus Dam Lake, Turkey

Emine Turgut Neary^{1,*}, Nermin Develi², Gülistan Özgül²

¹ Faculty of Aquaculture and Fisheries, Sinop University, Sinop, Turkey.

² Faculty of Agriculture, Gaziosmanpaşa University, Tokat, Turkey.

* Corresponding Author: Tel.: +90.368 2876254-55-62 Fax: +90.368 2876255-69;
E-mail: emineturgut5@yahoo.com

Received 16 June 2011
Accepted 21 October 2011

Abstract

The genus *Dactylogyrus* is the largest helminth genus parasitizing many fish species. Considering species richness of freshwater fish in Turkey, there are inadequate studies in Turkish freshwater fish. Therefore, a survey of *Dactylogyrus* species from four freshwater species was carried out to determine parasite diversity, the changes in their seasonal variation and host size dependent variability. A total of 4 *Dactylogyrus* species were found; these were *D. malleus* from *Barbus plebejus*, *D. alatusf. major* from *Alburnus orontis*, *D. vistulae* and *D. alatusf. major* from *Chondrostoma regium*, *D. naviculoides* and *D. vistulae* from *Leuciscus cephalus*. However, to our knowledge, this is the first time *D. malleus*, *D. alatusf. major* and *D. naviculoides* have been reported from Turkish freshwater fish. In general, prevalence and intensity of *Dactylogyrus* species were higher in spring and summer than autumn.

Keywords: *Dactylogyrus*, *D. malleus*, *D. alatus f. major*, *D. naviculoides*, *D. vistulae* *Chondrostoma regium*, *Barbus plebejus*, *Alburnus orontis*, *Leuciscus cephalus*

Almus Baraj Gölü (Türkiye)n'deki Sazangiller'de bulunan *Dactylogyrus* Türleri (Platyhelminths, Monogenean)

Özet

Dactylogyrus cinsi parazitler birçok balık türünü enfekte eden en genişhelmit cinsidir. Türkiye'de bulunan tatlı su balıklarının tür zenginliğini düşünecek olursak, Türkiye tatlısu balıklarında yeterli sayıda çalışma bulunmamaktadır. Bu nedenden dolayı, bu çalışma dört tatlı su balığı türünde bulunan *Dactylogyrus* türlerinin çeşitliliği, mevsimsel değişim ve konak balık büyüklüğüne bağlı değişimi belirlemek amacı ile yapılmıştır. Bu çalışmada *Barbus plebejus*'tan *D. malleus*, *Alburnus orontis*'ten *D. alatusf. major*, *Chondrostoma regium*'dan *D. vistulae* ve *D. alatusf. major*, *Leuciscus cephalus*'tan *D. naviculoides* ve *D. vistulae* olmak üzere toplam 4 *Dactylogyrus* türü tespit edilmiştir. Bu türlerden *D. malleus*, *D. alatusf. major* ve *D. naviculoides* Türkiye tatlısu balıklarından ilk defa bildirilmektedir. Dört balık türünde bulunan *Dactylogyrus* türlerinin mevsimsel dağılımındaki farklılıklar bu çalışmada sunulmuş. Genel olarak, parazit yaygınlığı ve yoğunluğu en yüksek bahar ve yaz, sonra sonbahar aylarında bulunmuştur.

Anahtar Kelimeler: *Dactylogyrus*, *D. malleus*, *D. alatus f. major*, *D. naviculoides*, *D. vistulae* *Chondrostoma regium*, *Barbus plebejus*, *Alburnus orontis*, *Leuciscus cephalus*

Introduction

The genus *Dactylogyrus* is the largest helminth genus, with more than 900 species and generally has high host specificity. Most *Dactylogyrus* species parasitize cyprinids although certain species are adapted to the more advanced fish families. Furthermore, commercial and aquaculture

exploitation of cyprinids caused examination of these species for potential pathogens (Gibson *et al.*, 1996).

There are reported to be 160 freshwater fish species in Turkey (Fishbase, 2011). This suggests that there might be many more *Dactylogyrus* species remaining to be described from Turkish freshwater fish. The Turkish *Dactylogyrus* fauna appears to be considerable poorer in the number of species

compared with that of the continental European fauna. Oktener (2003) listed 17 *Dactylogyrus* species and to our knowledge up to 31 *Dactylogyrus* species have been recorded (Oktener, 2003; Karatoy and Soylu 2006; Uzunay and Soylu, 2006; Soylu and Emre, 2007; Kir and Tekin-Ozan, 2007; Kayis et al., I. 2009; Turgut et al., 2011). Most of these records have been done from Western part of Turkey. However, there is not much study in middle and eastern part of Turkey.

Beside identification of *Dactylogyrus* species, understanding of their biology, especially effect of abiotic factor such as temperature has major importance on the population dynamics of parasites (Paperna, 1963a,b; Chubb, 1970; Hanzelova and Zitnan, 1985). Different species of *Dactylogyrus* show different temperature optima and seasonal changes in their infection parameters. Furthermore, the abundance of *Dactylogyrus* is often higher on older fish rather than younger fish (Koskivaara et al., 1991, 1992). Monogeneans have a narrow host range and often does not cause pathogenic problem in nature. However, under favorable aquaculture condition monogeneans may become pathogenic to the host. Therefore, having more information on the presence of parasite diversity, the changes in their seasonal variation and host size dependent variability would be helpful understanding their biology and thus to prevent possible problems might occur with *Dactylogyrid* infection.

The aims of the present study were to survey *Dactylogyrus* species in Almus Dam lake on Yesilirmak River from 4 freshwater fish species belonging to *Cyprinidae* family and also observing their seasonal changes and host size dependent variability.

Materials and Methods

The study was conducted in Almus Dam Lake (40° 22' 348" N - 36° 55' 789" E), located on the main branch of the Yeşilirmak River, Turkey. It is an important reservoir for fishing, fish farming and irrigation. It has a surface area of 31.3 km², 950 hm³ of water reserves and a maximum depth of 78 m. The lake exhibits oligotrophic characteristics during winter and mesotrophic characteristics during summer. The water temperature in winter was 4±0.9°C, while in spring, summer and autumn were 8.9±2.9°C, 21.3±1°C and 17.1±7.9°C, respectively.

A total of 216 fish belonging to 4 fish species were collected by seine net, 12m long by 1.2m deep and 1.2 x 1.2m bag size consisting of 12x12mm mesh size, every three months from April 2005 to January 2006. A total of 76 *Chondrostoma regium* (20.2± 4.4 cm), 40 *Barbus plebejus* (20.6 ± 10.4 cm), 40 *Alburnus orontis* (15.4± 3.5 cm) and 60 *Leuciscus cephalus* (20.1± 5.3 cm) were studied. In winter there were no fish caught due to low water temperatures (4 ± 0.9°C).

Fish were brought directly to the lab in lake water, and then examined on the day of arrival. Fish were killed by insertion of pointed needle into the brain via upper part of the eyes and by cutting the spinal cord, then the total length of fish was recorded for parasitological dissection. Gills were removed by means of a needle using a dissecting microscope. A drop of ammonium picrate-glycerin (Malmberg's fixative) (kindly provided from Dr. Andy Shinn, Institute of Aquaculture, Stirling University) was added at the edge of the coverslip (Malmberg, 1970) and observed using binocular light microscope at 100x magnification. *Dactylogyrus* spp. were identified by descriptive morphometric measurements of hamuli, marginal hook, copulatory organs and associated structure according to Bychowskaya-Pavlovskaya (1962).

The prevalence, mean abundance and intensity levels of the parasites species were determined according to Bush et al. (1997). The length of fish were divided into two classes; ≤ 15 cm, >15 cm for *B. plebejus* and *A. alburnus* and ≤ 20 cm, >20 cm for *C. regium* and *L. cephalus*. Kruskal-Wallis and Mann-Whitney analysis of variance was applied to the data to determine significant differences in the mean intensity of parasites in relation to seasons and length classes. All statistical analyses were performed using the statistical program SPSS 15.0.

Results

Four *Dactylogyrus* species were identified from 4 fish species belonging to *Cyprinidae* family. These were *D. malleus* from *Barbus plebejus*, *D. alatus* form *major* from *Alburnus orontis*, *D. vistulae* and *D. alatusf. major* from *Chondrostoma regium*, *D. naviculoides* and *D. vistulae* from *Leuciscus cephalus* (Table 1). Mixed infections of *Dactylogyrus* species were also observed. *Dactylogyrusvistulae* and *D. Alatusf. major* were associated together on *C. regium* and *D. naviculoides* and *D. vistulae* were found to occur together on *L. cephalus*.

Prevalence levels of *D. malleus* from *B. plebejus* was higher in spring (62.5%) and summer (59.3%) compared to the autumn (40%). *D. alatus f major* from *A. orontis* also showed similar result in prevalence level in summer (73.3%) followed by autumn (68.7%) and spring (66.7%). Mixed infection of *D. vistulae* and *D. Alatusf. major* from *C. regium* had higher prevalence in spring (70%) compared to summer (57%) and autumn (26%). Mixed infection of *D. naviculoides* and *D. vistulae* from *L. cephalus* had higher prevalence in summer (36%) and spring (34.8%) compared to the autumn (8.3%) (Table 1).

Seasonal changes in the mean abundance *Dactylogyrus* species was also higher in the summer compared to the spring and autumn. The abundance of *D. malleus* from *B. plebejus* and *D. alatusf. major* from *A. orontis* were higher in the summer (7.7 parasite/fish, 5.6 parasite/fish, respectively) than in

Table 1. Seasonal changes in prevalence, mean abundance and mean intensity of *Dactylogyrus* species from some Cyprinid fish in Almus Dam Lake, Turkey

	Spring			Summer			Autumn		
	P	MA	MI	P	MA	MI	P	MA	MI
<i>Barbus plebejus</i> (N= 40)		n= 8			n= 27			n= 5	
<i>Dactylogyrus malleus</i>	62.5	1.0	1.6±0.9 ^a	59.3	7.7	13.1±13.0 ^b	40.0	0.8	2.0±0 ^a
<i>Alburnus orontis</i> (N= 40)		n= 9			n= 16			n= 15	
<i>Dactylogyrus alatus f. major</i>	66.7	2.0	3.0±1.5 ^a	73.3	5.06	7.4±5.2 ^a	60.0	1.2	2±1.1 ^a
<i>Chondrostoma regium</i> (N=76)		n= 23			n=23			n=30	
<i>Dactylogyrus vistulae</i> and <i>Dactylogyrus alatus f. major</i> *	69.6	3.5	5.4±2.1 ^{ab}	63.0	11.9	18.8±28.3 ^b	26.1	0.9	3.5±2.3 ^a
<i>Leuciscus cephalus</i> (N= 60)		n= 23			n= 25			n= 12	
<i>Dactylogyrus naviculoides</i> and <i>Dactylogyrus vistulae</i> *	34.8	0.7	2.3±0.4 ^a	36.0	2.08	5.8±4.6 ^b	8.3	0.2	2.0±0 ^a

P: Prevalence (%), MA: Mean Abundance, MI: Mean Intensity, * mixed infection of two *Dactylogyrus* species

the spring (1 parasite/fish, 2 parasite/fish, respectively) and in the autumn (0.8 parasite/fish, 0.7 parasite/fish, respectively). Similar results were observed for mixed infection of *D. vistulae* and *D. alatus f. major* from *C. regium* and *D. naviculoides* and *D. vistulae* from *L. cephalus* having higher abundance in summer (11.7 parasite/fish, 2.08 parasite/fish, respectively) than in the spring (9.9 parasite/fish, 0.7 parasite/fish, respectively) and in the autumn (0.7 parasite/fish, 0.2 parasite/fish, respectively).

Dactylogyrus species from 4 fish species showed similar results in their seasonal changes of the mean intensity level. The intensity of *D. malleus* from *B. plebejus* and *D. alatus f. major* from *A. orontis* were higher in the summer (7.7 parasite/fish, 5.6 parasite/fish, respectively) than in the spring (1 parasite/fish, 2 parasite/fish, respectively) and in the autumn (0.8 parasite/fish, 0.7 parasite/fish, respectively). *D. malleus* showed significantly higher intensity in the summer than in the spring and autumn. Similar results were observed for mixed infection of *D. vistulae* and *D. alatus f. major* from *C. regium* and *D. naviculoides* and *D. vistulae* from *L. cephalus* in the mean intensity. Higher intensity of *Dactylogyrus* spp. from *C. regium* and *L. cephalus* were observed in summer (20.6 parasite/fish, 7.8 parasite/fish, respectively) than in the spring (14.3 parasite/fish, 2.3 parasite/fish, respectively) and in the autumn (2.6 parasite/fish, 2 parasite/fish, respectively). Significantly higher intensity of *Dactylogyrus* spp. were observed in the summer than in the spring and in the autumn from *B. plebejus* ($p < 0.05$) and *L. cephalus* and *C. regium*. Intensity of *D. alatus f. major* from *A. orontis* did not show any significant relationship between seasons (Table 1).

The infection parameters of *Dactylogyrus* spp. in the two size classes of fish species studied are given in Table 2, Figures 1,2,3,4 Parasite burden of *Dactylogyrus* spp. on different fish species did not

vary much with length of fish (Figures 1,2,3,4). In overall, prevalence and mean intensity of *D. malleus* infection in *B. plebejus* ≤ 15 cm was higher (%75 and 10.8 parasite/fish) compare to fish > 15 cm (40%, 7.5 parasite/fish). Overall infectious parameters, prevalence and mean intensity for *D. alatus f. major* is also slightly higher in *A. orontis* ≤ 15 (71.4%, 5.5 parasite/fish, respectively) compared to fish > 15 cm size group (63.2%, 2.8 parasite/fish, respectively). *Dactylogyrus* spp. infection from *C. regium* also showed similar level of prevalence and mean intensity in fish ≤ 20 cm (55.2, 17.7 parasite/fish, respectively) compare to fish > 20 cm (51.1%, 7.8 parasite/fish, respectively). The infection parameters for *Dactylogyrus* spp. from *L. cephalus* was also similar in fish ≤ 20 cm (24.14 %, 5.4 parasite/fish) compared to fish > 20 cm (35.5%, 3.1 parasite/fish). Furthermore, there was no significant relationship in the intensity of *Dactylogyrus* spp. between the length classes of fish ($P > 0.05$) (Table 2).

Discussion

Monogenean species are well known for their high degree of host specificity (Jarkovsky *et al.*, 2004). In the present study, *D. vistulae* and *D. alatus f. major* were recorded from 2 fish species and also Jarkovsky *et al.* (2004) considered them as a generalist parasitizing variety of Cyprinid fish. Whereas, *D. malleus* and *D. naviculoides* show specialist characteristics parasitizing only *Barbus barbus* and *L. cephalus*, respectively (Jarkovsky *et al.*, 2004). All these species are recorded to be geographical origin of Palaearctic species (Gibson *et al.*, 1996).

Due to the mix infection of *Dactylogyrus* species, it was not possible accurately determine the seasonal variation in prevalence and intensity of these species. Therefore, prevalence and intensity of these

Table 2. Infection parameters of *Dactylogyrus* species in the two size classes of fish studies

	≤ 15cm								> 15cm							
	Spring		Summer		Autumn		Overall		Spring		Summer		Autumn		Overall	
	P	MI	P	MI	P	MI	P	MI	P	MI	P	MI	P	MI	P	MI
<i>Barbus plebejus</i> N=40	n=7		n=12		n=1		n=20		n=1		n=15		n=4		n=20	
<i>Dactylogyrus malleus</i>	71.4	1.6 ±0.9	91.7	14 ±13.9	-	-	75	10.8 ±13 ^a	-	-	40	9.3±11	50	2±0	40	7.5±10.5 ^a
<i>Alburnus orontis</i> N=40	n=6		n=13		n=2		n=21		n=3		n=3		n=13		n=19	
<i>Dactylogyrus alatus f. major</i>	66.7	3.75 ±1.6	76.9	6.6 ±5.7	50	2±0	71.4	5.5±4.9 ^a	66.7	1.5 ±0.7	66.7	7.5 ±0.7	61.5	2 ±1.2	63.2	2.8 ±2.4 ^a
<i>Chondrostoma regium</i> N=76	n=1		n=17		n=11		n=29		n=22		n=13		n=12		n=47	
<i>Dactylogyrus vistulae</i> and <i>Dactylogyrus alatus f. major</i> *	-	-	82.3	20 ±30.9	18.2	1.5±0.7	55.2	17.7 ±31 ^a	68.2	5.4 ±2.1	23.1	26±25.9	33.3	3.75 ±2.9	51.1	7.8±12.3 ^a
<i>Leuciscus cephalus</i> N=60	n=4		n=17		n=8		n=29		n=19		n=8		n=9		n=31	
<i>Dactylogyrus naviculoides</i> and <i>Dactylogyrus vistulae</i> *	25	3±0	41	5 ±4.5	-	-	24.1	5.4±4.1 ^a	36.8	2.1 ±0.4	37.5	5.7±6.3	25	2±0	35.5	3.1±3.3 ^a

P: Prevalence (%), MI: Mean Intensity, *, mixed infection of two *Dactylogyrus* species

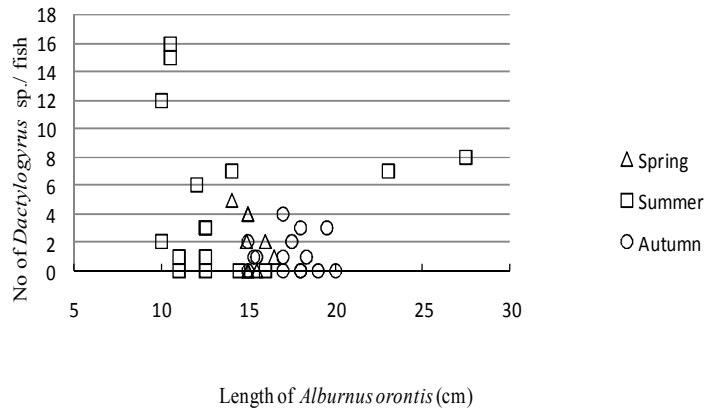


Figure 1. Number of *Dactylogyrus alatus f. major* from *Alburnus orontis* in relation to fish size (cm).

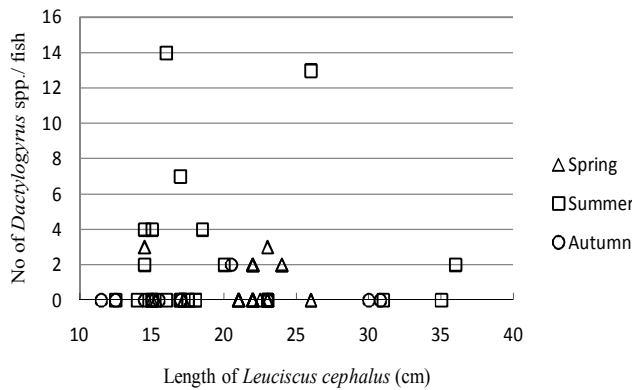


Figure 2. Number of *Dactylogyrus* spp. from *Leuciscus cephalus* in relation to fish size (cm).

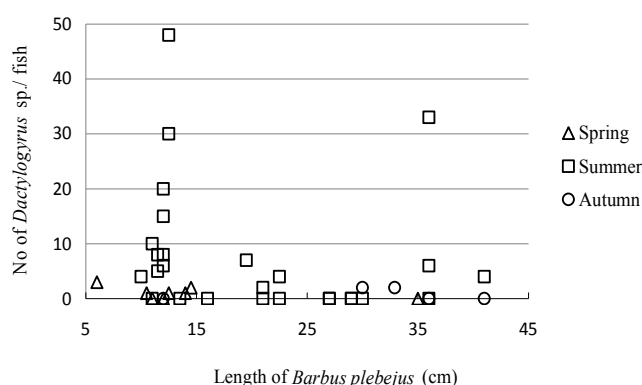


Figure 3. Number of *Dactylogyrus malleus* from *Barbus plebejus* in relation to fish size (cm).

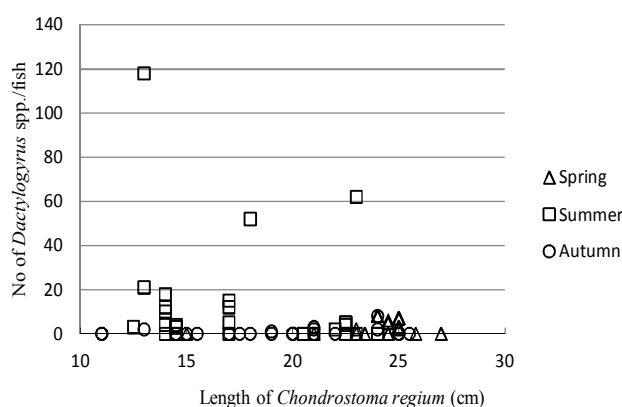


Figure 4. Number of *Dactylogyrus spp.* from *Chondrostoma regium* in relation to fish size (cm)

species was not separately determined. However, this is the first time *D. alatus f. major* from *C. regium* and *A. orontis*, *D. naviculoides* from *L. cephalus* and *D. malleus* from *B. plebejus* have been recorded from Turkish freshwater fish.

In general, species of *Dactylogyrus* show seasonal changes in their population dynamics. Present study showed that the prevalence of species were higher in the spring and summer when water temperature were $8.9 \pm 2.9^\circ\text{C}$, $21.3 \pm 1^\circ\text{C}$, respectively and lower in the autumn, water temperature of $17.1 \pm 7.9^\circ\text{C}$. Although, prevalence of *Dactylogyrus* species were highest in spring on *B. plebejus* and *C. regium*, mean intensity of *Dactylogyrus* species were recorded to be highest in the summer. The increased *Dactylogyrus* infection in spring and summer agree with other studies, which report the favorable temperature of the warmer season on reproduction (Stojanovsky *et al.*, 2010; Koyun, 2011; Turgut *et al.*, 2011). Koyun (2011) also agreed with our results and reported highest *D. alatus* infection from *A. alburnus* in the summer. Furthermore, highest prevalence of *D. malleus* from *B. barbuis* reported in the spring (Kadlec *et al.*, 2003; Stojanovsky *et al.*, 2010). Although, temperature and seasonal changes have

major influence on population dynamics of *Dactylogyrus* species (Chubb, 1970; Hanzelova and Zitnan, 1985). There are other abiotic and biotic factors such as oxygen, salinity, water pollution, host size, host physiology, host hormonal status and host immunological responses effecting population of *Dactylogyrus* species (Bauer, 1962; Hanzelova and Zitnan, 1985; Simkova *et al.*, 2005). Especially, the seasonal changes in host reproduction are an important factor influencing host-parasite interaction. Fish are more susceptible to parasite infection in periods of reproduction; this coincides with increasing reproduction of monogeneans as water temperature rises (Hanzelona and Zitnan, 1985; Simkova *et al.*, 2005; Ozturk and Altunel, 2006). In our study, *Dactylogyrus* infection often peaked in spring and summer, this time also coincides with the reproduction period for most of the Cyprinid fish in the lake.

As regards the relationship between the level of *Dactylogyrus* infection and the size of host fish, there have been several researches indicating that the abundance of *Dactylogyrus* is often higher on older fish than younger fish (Loo *et al.*, 1998; Ozer and Ozturk, 2005; Ozturk and Altunel, 2006). Ozturk and

Altunel (2006) found that *D. cornu*, *D. crucifer* and *D. sphyrna* are more abundant in older fish than younger fish. Aydogdu et al. (2003) also agreed with them reporting positive relationship between the intensity of *D. extensus* and size of the host, *C. carpio*. However, Ozturk and Altunel (2006) reported that the abundance of *D. difformis* infection was higher in younger fish than in older fish. On the contrary, some researchers have demonstrated no relationship between parasite intensity and host size (Kadlec et al., 2003; Tekin-Ozan et al., 2008). The present results agreed with Kadlec et al. (2003) and Tekin-Ozan et al. (2008) with having no significant relationship between abundance of parasites and length of their host.

In this study, survey of *Dactylogyrus* species demonstrated three *Dactylogyrus* species to be new Turkish record from *B. plebejus*, *A. orontis*, *C. regium* and *L. cephalus* and is giving information first time about *Dactylogyrus* species from these fish species in Yesilirmak River. Furthermore, seasonal changes of parasite population and host size depended variation were also demonstrated.

Acknowledgements

This work was supported by Gaziosmanpasa University with a BAP Project no: 2004/12

References

- Aydođdu, A., Kostadinova, A. and Fernandez, M. 2003. Variations in the distribution of parasites in the common carp, *Cyprinus carpio*, from Lake Iznik, Turkey: population dynamics related to season and host size. *Helminthologia*, 40(1): 33-40.
- Bauer, O.N. 1962. Parasites of freshwater fish and the biological basins for their control. Israel Program Scientific Translations, Jerusalem.
- Bychowskaya-Pavlovskaya, I.E. 1962. Key to parasites of freshwater fish of the USSR. Moskva-Leningrad: Izdatel'stvo Akademii Nauk SSR. In Russian: English Translation-Israel Program for Scientific Translation.
- Bush, A. O., Lafferty, K. D., Lotz, J. M., Shostak, A. W. 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. *Journal of Parasitology*, 83: 575-583. doi:10.2307/3284227
- Chubb, J.C. 1970. The Parasite Fauna of British Freshwater Fish. In *Aspects of Fish Parasitology*, Symposium of British Society Parasitology, 8, 119-144.
- Gibson, D. I., Timofaeva, T. A. and Gerasev, P.I. 1996. A catalogue of the nominal species of the monogenean genus *Dactylogyrus* Diesing, 1850 and their host genera. *Systematic Parasitology*, 35: 3-48. doi:10.1007/BF00012180
- Hanzelova, V. and Zitnan, R. 1985. Epizootiologic importance of the concurrent monogenean invasion in carp. *Journal of Helminthologia*, 22: 277-283.
- Fishbase, 2011. List of Freshwater Fishes for Turkey. <http://fish.mongabay.com/data/Turkey.htm> (accessed May 25, 2011)
- Jarkovsky, J., Morand, S., Simkova, A., Gelnar, M. 2004. Reproductive barriers of congeneric monogenean parasites (*Dactylogyrus*: Monogenea): attachment apparatus morphology or copulatory organ incompatibility?. *Parasitology Research*, 92(2): 95-105.
- Kadlec, D., Simkova, A. and Gelnar, M. 2003. The microhabitat distribution of two *Dactylogyrus* species parasitizing the gills of the barbell, *Barbus barbus*. *Journal of Helminthology* 77: 317-325. doi:10.1079/JOH2003183
- Karatoy, E. and Soyly, E. 2006. Metazoan parasites of Bream (*Abramys brama* Linnaeus, 1758) in the Lake Durusu (Terkos). *Acta Parasitologica Turcica*, 30: 233-238.
- Kayis, S., Capkin, E., Ozcelep, T., Altinok, I. 2009. Protozoan and metazoan parasites of fish in the Turkey and their treatment. *Israeli Journal of Aquaculture*, 61: 93-102.
- Kır, İ., Tekin-Özan, S. 2007. Helminth Infections in Common Carp, *Cyprinus carpio* L., 1758 (Cyprinidae) from Kovada Lake (Turkey). *Acta Parasitologica Turcica*, 31(3): 232-236.
- Koskivaara, M., Valtonen, E.T. and Prost, M. 1991. Dactylogyrids on the gills of roach in central Finland, features of infection and species composition. *International Journal for Parasitology*, 21: 565-572. doi:10.1016/0020-7519(91)90061-B
- Koskivaara, M. and Valtonen, E. T. 1992. *Dactylogyrus* (Monogenea) communities on the gills of roach in three lakes in Central Finland. *Parasitology*, 104: 263-272. doi:10.1017/S0031182000061709
- Koyun, M. 2011. Seasonal distribution and ecology of some *Dactylogyrus* species infecting *Alburnus alburnus* and *Carassius carassius* (Osteichthyes: Cyprinidae) from Porsuk River, Turkey. *African Journal of Biotechnology*, 10 (7): 1154-1159.
- Loo, C.M., Morand, S., Galzin, R. 1998. Parasite diversity/host age and size relationship in three coral-reef fishes from French Polynesia. *International Journal Parasitology*, 28: 1695-1708
- Malmberg, G. 1970. The excretory systems and the marginal hooks as a basis for the systematics of *Gyrodactylus* (Trematoda, Monogenea). *Arkiv for Zoology*, 23: 1-235.
- Oktener, A. 2003. A checklist of metazoan parasites recorded in freshwater fish from Turkey. *Zootaxa*, 394: 1-28
- Ozer, A. and Ozturk, T. 2005. *Dactylogyrus cornu* Linstow, 1878 (Monogenea) Infestations on *Vimba vimba tenella* (Nordmann, 1840) caught in the Sinop Region of Turkey in Relation to the Host Factors. *Turkish Journal of Veterinary and Animal Sciences*, 29: 1119-1123.
- Ozturk, M.O. and Altunel, F.N. 2006. Occurrence of *Dactylogyrus* infection linked to seasonal changes and host fish size on four cyprinid fishes in lake Manyas, Turkey. *Acta Zoologica Academiae Scientiarum Hungaricae*, 52 (4): 407-415.
- Paperna, I. 1963a. Some observations on the biology of *Dactylogyrus vastator* in Israel. *Bamidgeh*, 15: 8-28.
- Paperna, I. 1963b. Dynamics of *Dactylogyrus vastator* Nybelin (*Monogenea*) populations on the gills of carp fry in fish ponds. *Bamidgeh*, 15:31-50.
- Simkova, A., Jarkovsky, J., Koubkova, B., Varus, V. and Prokes, M. 2005. Associations between fish reproductive cycle and the dynamics of metazoan parasite infection. *Parasitology Research*, 95: 65-72.
- Soyly, E., Emre, Y. 2007. Monogenean and Cestode

- parasites of *Pseudophoxinus antalyae*, Bogutskaya 1992 and *Cyprinus carpio*, Linnaeus 1758 from Kepez Antalya, Turkey. European Association of Fish Pathologist, 27 (1): 23-29.
- Stojanovski, S., Hristovski, N., Cakic, P., Hristovski, M., Velkova Jordanoska, L. And Blazekovic, D. 2010. Biotechnol and Biotechnol EQ, Second Balkan Conference on Biology 21-23 May 2010, Plovdiv 623-627.
- Tekin-Ozan, S., Kir, I. and Barlas, M. 2008. Helminth parasites of common carp (*Cyprinus carpio* L., 1758) in Beyşehir lake and population dynamics related to month and host size. Turkish Journal of Fisheries and Aquatic Sciences, 8: 201-205.
- Turgut, E., Ozgul, G. and Buhan, E. 2011. Seasonal changes of metazoan parasites in *Capoeta tinca* and *Capoeta capoeta* in Almus Dam Lake, Turkey. European Association of Fish Pathologist, 31 (1):23-30.
- Uzunay, E. and Soylu, E. 2006. Metazoan parasites of carp (*Cyprinus carpio* Linnaeus, 1758) and vimba (*Vimba vimba* Linnaeus, 1758) in the Sapanca Lake. Acta Parasitologica Turcica, 30 (2): 141-150.