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

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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. alatus* major from *Alburnus orontis*, *D. vistulae* and *D. alatus* major from *Chondrostoma regium*, *D. naviculoides* and *D. vistulae* from *Leuciscus cephalus*. However, to our knowledge, this is the first time *D. malleus*, *D. alatus* 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* 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


Anahtar Kelimeler: *Dactylogyrus*, *D. malleus*, *D. alatus* 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 considerably 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., 1. 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). Monogenans 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 Dactylogyrus infection.

The aims of the present study were to survey Dactylogyrus species in Almus Dam lake on Yeşilirmak 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± 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 picate-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. Dactylogyrus vistulae and D. Alatus. major were associated together on C. regium and D. naviculoides and D. vistulae were found tooccur 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. Alatus. 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
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) compared 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 (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

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

<table>
<thead>
<tr>
<th>Species</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P</td>
<td>MA</td>
<td>MI</td>
</tr>
<tr>
<td><em>Barbus plebejus</em> (N= 40)</td>
<td>n= 8</td>
<td>n= 27</td>
<td>n= 5</td>
</tr>
<tr>
<td><em>Dactylogyrus malleus</em></td>
<td>62.5</td>
<td>1.0</td>
<td>1.6±0.9a</td>
</tr>
<tr>
<td><em>Alburnus orontis</em> (N= 40)</td>
<td>n= 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dactylogyrus alatus f major</em></td>
<td>n= 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Chondrostoma regium</em> (N=76)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dactylogyrus vistulae</em> &amp; <em>Dactylogyrus alatus f major</em></td>
<td>69.6</td>
<td>3.5</td>
<td>5.4±2.1ab</td>
</tr>
<tr>
<td><em>Leuciscus cephalus</em> (N= 60)</td>
<td>n= 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dactylogyrus naviculoides</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dactylogyrus vistulae</em></td>
<td>34.8</td>
<td>0.7</td>
<td>2.3±0.4a</td>
</tr>
</tbody>
</table>

P: Prevalence (%), MA: Mean Abundance, MI: Mean Intensity, * mixed infection of two *Dactylogyrus* species
Table 2. Infection parameters of *Dactylogyrus* species in the two size classes of fish studies

<table>
<thead>
<tr>
<th>Species</th>
<th>≤ 15cm</th>
<th>&gt; 15cm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring</td>
<td>Summer</td>
</tr>
<tr>
<td><em>Barbus plebejus</em> N=40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P=7</td>
<td>MI=12</td>
</tr>
<tr>
<td><em>Dactylogyrus malleus</em></td>
<td>71.4 ±0.9</td>
<td>14 ±13.9</td>
</tr>
<tr>
<td><em>Alburnus orontis</em> N=40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P=6</td>
<td>MI=13</td>
</tr>
<tr>
<td><em>Dactylogyrus alatus</em> f major</td>
<td>66.7 ±1.6</td>
<td>76.9 ±5.7</td>
</tr>
<tr>
<td><em>Chondrostoma regium</em> N=76</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P=1</td>
<td>MI=17</td>
</tr>
<tr>
<td><em>Dactylogyrus vistulae</em> and</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dactylogyrus alatus</em> f major*</td>
<td>-</td>
<td>82.3 ±30.9</td>
</tr>
<tr>
<td><em>Leuciscus cephalus</em> N=60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P=4</td>
<td>MI=17</td>
</tr>
<tr>
<td><em>Dactylogyrus naviculoides</em> and <em>Dactylogyrus vistulae</em></td>
<td>25 ±0</td>
<td>41 ±4.5</td>
</tr>
</tbody>
</table>

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).
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±2.9°C, 21.3±1°C, respectively and lower in the autumn, water temperature of 17.1±7.9°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. barbusis* 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. sphyra are more abundant in older fish than younger fish. Aydoğdu 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

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