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Full Length Research Paper

An investigation on *Argulus foliaceus* infection of rudd, *Scardinius erythrophthalmus* in Lake Manyas, Turkey

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In this study, *Argulus foliaceus* L. (Crustacea: Branchiura) infection of one cyprinid fish species, rudd (*Scardinius erythrophthalmus*) in Lake Manyas, Turkey was examined on the basis of samples taken from on-site surveys carried out between December 1996 and November 1998. Of the 135 *S. erythrophthalmus* examined, 32 (23.7%) was infected with *A. foliaceus*. The distribution on microhabitat locality of *A. foliaceus* was found to be as follows: 3%, 3.2 ± 0.5 specimens/fish on oral cavity; 6%, 4.9 ± 0.5 on the gills; 6%, 5.9 ± 0.9 on the fins and 6%, 8.9 ± 1.5 on the skin. However, it was not a statistically meaningful differences among the microhabitat locality (*P > 0.05*). Moreover in this study, *A. foliaceus* infection was investigated depending on the years, and seasons, and host fish size.

Key words: *Argulus, Cyprinus, Lake Manyas, Scardinius erythrophthalmus.*

INTRODUCTION

The study area, Lake Manyas, was in Northwest Turkey, located at 41° 11' N, 27° 58' E. It is a natural, eutrophic, and shallow lake (mean depth ca. 4 m) with a surface area of 150 km^2, and an altitude of 15 m. The lake has an average water temperature of 24.5°C in summer and 7.6°C in winter with no freeze. The most common fish species in the lake are common carp (*Cyprinus carpio*), pike (*Esox lucius*), rudd (*Scardinius erythrophthalmus*), roach (*Rutilus rutilus*), sandgoby (*Gobius fluviatilis* L.) and white bream (*Vimba vimba*) (Balik, 1987).

To date, several studies have investigated parasite fauna of the Lake Manyas. Öztürk and Altunel (2001) identified three species of cestodes (*Caryophyllaeus laticeps, Caryophyllaeides fennica, Ligula intestinalis plerocercoid*) in *B. bjoerkna, R. rutilus*, *S. erythrophthalmus*, *V. vimba*. By a different study, Öztürk and Altunel (2002) found one species, *Dactylogyrus chalcalburni* (Monogenea), on the gills of *Chalcalburnus chalcoides*. In other study, Öztürk and Altunel (2006a) four *Dactylogyrus* species were identified on the gills of host fishes: *Dactylogyrus sphyrna* on *Blicca bjoerkna*, *Dactylogyrus crucifer* on *Rutilus rutilus*, *Dactylogyrus difformis* on *Scardinius erythrophthalmus*, *Dactylogyrus cornu* on *Vimba vimba*.. In addition to these studies, Öztürk and Altunel (2006b) also examined *C. carpio* in the same lake and identified five parasite species were found: *Dactylogyrus extensus* (Monogenea), *Bothriocephalus acheilognathi, C. laticeps* (Cestoda) and *Pseudocapillaria tomentosa* (Nematoda), *Argulus foliaceus* (Crustacea).

The aim of this study was to investigate the existence of crustacean parasite fauna on rudd, *S. erythrophthalmus* in Lake Manyas, Turkey. It also aimed to determine changes in the intensity and prevalence level of the parasite species depending on years and seasons, and host fish sizes. Within this context, this paper offers some new data concerning the results of research on *A. foliaceus* with respect to the cause of infections for one cyprinid fish species in Lake Manyas, Turkey.

MATERIALS AND METHODS

Sampling methods and laboratory analysis

During the study period, 4 to 13 rudd, samples were taken on a monthly basis from December 1996 to November 1998. The fish specimens were caught by local fishermen using gill-nets. The samples were placed in plastic containers filled with local lake water and then immediately transferred to the research laboratory. They were kept in an aquarium and examined within 24 h. After sacrificed, the lengths of the fishes were recorded and the skin, fins, gills, and oral cavity were cut off the body, and placed in

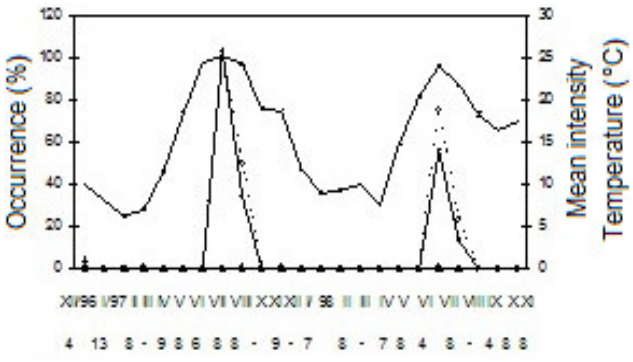

Figure 1. Ocurrence (broken line) and mean intensity (solid line) of A.foliaceus and water temperation (*) of Lake Manyas during the study period.

examined and the parasites were isolated with the help of a stereo separate petri dishes with physiological solution. They were microscope with *x*12 and *x*30 magnification.

The *A. foliaceus* was then preserved in ethanol to make way for further examination. Some of the parasites were fixed in glacial acetic acid and preserved using glycerine-gel under the cover glass in accordance with Pritchard and Kruse (1982). For the identification of the parasite specimens, based on Bychowskaya-Pavlovskaya, (1962) a light microscope with *x*100 and *x*400 magnification was used.

Statistical analysis

Total number of parasites was determined directly numerical count. Prevalence and intensity of infection was calculated for each parasite species in accordance with the method by Margolis et al. (1982). Spearman's test was used to measure correlation between the intensity of each parasite species and host fish size. Kruskal-Wallis analysis of variance was applied to the data to determine the existence of any meaningful difference in mean intensity of the parasite species. All statistical analyses were performed using the statistical program SPSS 10.0.

RESULTS

In this study, of the 135 *S. erythrophthalmus* examined, 32 (23.7%) was infected with *A. foliaceus* (L. 1758) (Crustacea: Branchiura). The parasite species founded on microhabitat locality of the host fishes: on oral cavity (3%, 3.2 ± 0.5 parasite/fish), gills (6%, 4.9 ± 0.5), fins (6%, 5.9 ± 0.9) and skin (6%, 8.9 ± 1.5) of the host fish. On skin region of the host fish, while prevalence and mean intensity of *A. foliaecues* was higher than the other microhabitats, it was the lowest of the parasite species on oral cavity of rudd. But there were no significant differences among the microhabitat locality ($P > 0.05$).

Parasite-seasonal changes relationship

The study has findings which are related to the parasite species linked to the host fish; prevalence and intensity levels on the basis of years, seasons, and host fish size.

In this connection, it is related to the prevalence and intensity levels on the basis of the years in the study periods. As such, it was found in both years of the study periods. However, prevalence and mean intensity of the parasite species was higher in 1998 than in 1997, but there was no statistically significant difference among the two years ($P > 0.05$).

The finding of the study is linked to seasonal changes in the prevalence and intensity levels of the parasite species as shown in Figure 1. The figure clearly shows that the changes in the water temperature in the study area were not constant, that is, it changes sharply during different months from spring to winter. As it is seen, the occurrence of the parasite species was found in summer time, from July to August, when water temperature was rising, providing the optimum phase of reproduction for the parasite. Prevalence of the parasite sharply increased in July, and the mean intensity gradually decreased throughout the August. It was not found on the other months ($P < 0.05$).

Parasite-host length changes relationship

The other finding of the study is connected to prevalence and intensity levels of the parasite species on the basis of host fish sizes given in Figure 2. Both the prevalence and mean intensity levels of the parasite species varied in different host fish size. It was particularly founded on smaller host fish specimens and its prevalence was observed higher on such specimens than bigger ones. While it had a maximum mean intensity on the second group of the host fish size, it was not found on the largest host fish specimens ($P > 0.05$).

DISCUSSION

Argulids are common obligate crustacean fish ectoparasites which are not highly host specific fishes (LaMarre and Cochran, 1992; Holland and Kennedy, 1997). They have high species intensity on the gills, fins and skins of cyprinid fishes: *A. foliaceus* was found on the skin of common carp specimens by Pojmanska and Chabros (1993); on fins of *Stizosteidon lucioperca* by Molnar and Székely (1995); on gill filaments, fins, and skin of *Leuciscus idus* by Sterud and Appleby (1997); on gills, oral cavity, and external surfaces of common carp by Appleby and Sterud (1996); and on both skin and fins by Özer and Erdem (1999); skin, fins, gills and oral cavity of common carp by Öztürk and Altunel (2006b). Similarly, the results of the present study have demonstrated the presence of the parasite species in or on four different habitats: skin, fins, gills and oral cavity of the host fish. Temperature is commonly regarded as one of the most important factors determining the existence and 1992; Harrison et al., 2006). Öztürk and Bulut (2006)

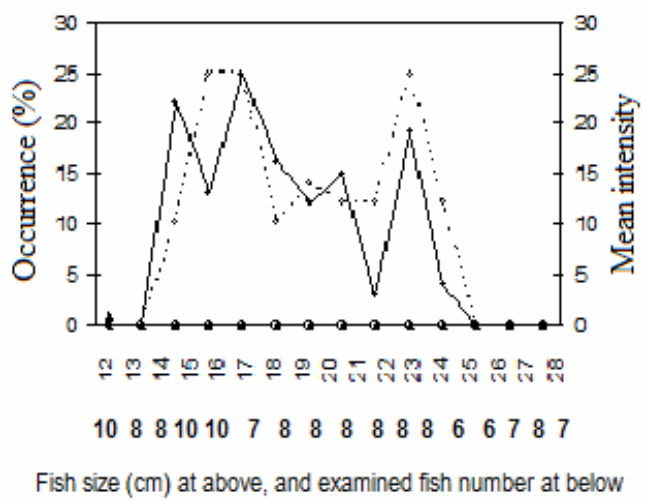

Figure 2. Occurence (broken line) and mean intensity (solid line) of *A. Foliaceus* in relation to size groups of the host fish.

abundance of argulid parasites (Shafir and Oldewage, (1992) found that the optimum period for the growth of *A. foliaceus* was in summer and the maximum infection level for the parasites was on the period. This increase can be explained by the temperature requirements of the parasite. Subsequently, as found by other investigators, the level of infection decreased in the cooler months (Molnar and Szekely, 1995; Öztürk and Altunel, 2006b). This study also supports this view, with the prevalence and mean intensity of the parasite was recorded during summer, and the other seasonal periods with no infection. The findings are also in agreement with those of other researchers (Özer and Erdem, 1999; Harrison et al., 2006).

As regards the relationship between the level of *Argulus* infection and the size of the host fish, there have been several researches. As one of them, Öztürk and Bulut (2006) found that the parasite mainly infected larger fish, and increased mean intensity appeared related to fish size, e.g. a mean of 260 parasites was found on the largest host and 14 specimens on the smallest. Therefore, they concluded that *Argulus* infection increased with age of host fish due to the fact that the older fish have a larger gill surface area with no permanent immunity against these parasites. On the other hand, the species was more abundant in young host fishes than older ones in parallel with the results published in an earlier work by Öztürk (2005). The findings of this study also support the conclusions of Pojmańska and Chabros (1993) who found *A. foliaceus* in common carp aged 0 to 2 years. The other study, *A. foliaceus* infection was found to be more common among smaller than larger host fish specimens (Öztürk and Altunel, 2006b). The present study is in parallel with this conclusion regarding the species, *A. foliaceus* it determined.

Parasitic crustacean species belonging to the *Argulus* represent potentially serious pathogenic parasites to which many fish species are susceptible (Heckmann, 1993; Mikheev et al., 2001; Northcott et al., 1997). These parasites cause lesions which are susceptible to secondary, often fatal, bacterial and fungal infections (Gresty et al., 1993). In the same way, it should also be noted that local ulcers have been identified on gills of both of the host fish species analyzed in this study. Similar results, including hemorrhages on the host's skin, have been recorded by Bauer (1962). It is hoped that, this study will make a contribution to the literature of what we know about the extremely dangerous presence of the parasites on the fish population, specifically in the Lake of study area.

Conclusion

In conclusion, a new host fishes, Lake Manyas is found for existence of the parasite species. In this connection, it contributes to the existing studies, focusing on the relationship between parasite species and host fish species in a different geographical location. It is hoped, therefore, that this study will make a contribution to the literature of what we know about the extremely dangerous presence of the parasites on the fish population, specifically in Lake Manyas, Turkey.

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