

OCCURRENCE OF *DACTYLOGYRUS* INFECTION LINKED TO SEASONAL CHANGES AND HOST FISH SIZE ON FOUR CYPRINID FISHES IN LAKE MANYAS, TURKEY

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In this study, dactylogyrid parasites on the gills of four cyprinid fishes (*Blicca bjoerkna*, *Rutilus rutilus*, *Scardinius erythrophthalmus*, *Vimba vimba*) in Lake Manyas, Turkey, were examined on the basis of samples taken from on-site surveys carried out between January–1997 and November–1998. The intensity of *Dactylogyrus* infection was investigated depending on the parasite species, the years and seasons, and host fish size. Four *Dactylogyrus* species were identified on the gills of host fishes: *D. sphyrna* on *B. bjoerkna*, *D. crucifer* on *R. rutilus*, *D. difformis* on *S. erythrophthalmus*, *D. cornu* on *V. vimba*. The prevalence and mean intensity of *Dactylogyrus* infection for each parasite species was determined as follows: *D. crucifer* (41.5%, 10.65±5.79 specimens/fish), *D. cornu* (14.2%, 30.24±11.30), *D. difformis* (28.1%, 31.71±30.95), *D. sphyrna* (28.7%, 16.76±16.88). While maximum intensity was recorded for *D. difformis*, the lowest was for *D. crucifer*. However, it was not a statistically meaningful difference for all the parasite species. As regards the prevalence of the parasite species depending on the years, it was observed higher in 1998 than in 1997. Regarding the seasonal changes in the intensity and prevalence level, a very sharp decrease in the intensity levels of the parasite species was determined for the three fish parasites, except *D. crucifer*, between the late autumn and winter.

Key words: *Dactylogyrus*, seasonal changes in parasite species, Lake Manyas, Turkey

INTRODUCTION

Dactylogyrids are common monogenean parasites which are usually numerous and have a high species intensity on the gills of cyprinid fishes. The parasites are also highly host specific, that is, they tend to make a community on a particular host fish (KOSKIVAARA *et al.* 1991).

At least 10 freshwater fish species exist in Lake Manyas, Turkey. The most common species include rudd (*Scardinius erythrophthalmus*), roach (*Rutilus rutilus*), common carp (*Cyprinus carpio*), white bream (*Blicca bjoerkna*), Danube bleak (*Chalcalburnus chalcoides*), sand goby (*Gobius fluviatilis*) (ERK'AKAN 1997). To date, several researchers have investigated parasite fauna of particular fish species in Lake Manyas. ÖZTÜRK and ALTUNEL (2001) investigated the presence of endohelminth parasite species in *Blicca bjoerkna*, *Rutilus rutilus*, *Scardinius*

erythrophthalmus, *Vimba vimba* and found three species of cestoda (*Caryophyllaeus laticeps*, *Caryophyllaeides fennicus*, *Ligula intestinalis*-plerocercoid). In another study on danube bleak (*Chalcalburnus chalcooides*), ÖZTÜRK and ALTUNEL (2002) identified one species of monogenea, *Dactylogyrus chalcalburni*.

The aim of this study was to investigate the existence of dactylogyrid parasite fauna on four cyprinid fishes in Lake Manyas, Turkey. Moreover, it aimed to determine changes in *Dactylogyrus* species intensity and prevalence level depending on years and seasons, and host fish size. In the former respect, the present study is particularly interesting given that so little is known about the seasonality of *Dactylogyrus* species in Asia Minor, Turkey.

MATERIALS AND METHODS

The study area was in Northwest Anatolia, located at 41°11'N, 27°58'E (Fig. 1). It is a natural, eutrophic, and shallow lake (mean depth ca. 4 m) with a surface area of 150 km². The lake has an average water temperature 25–26 °C in June and it does not freeze in winter (ERK'AKAN 1997).

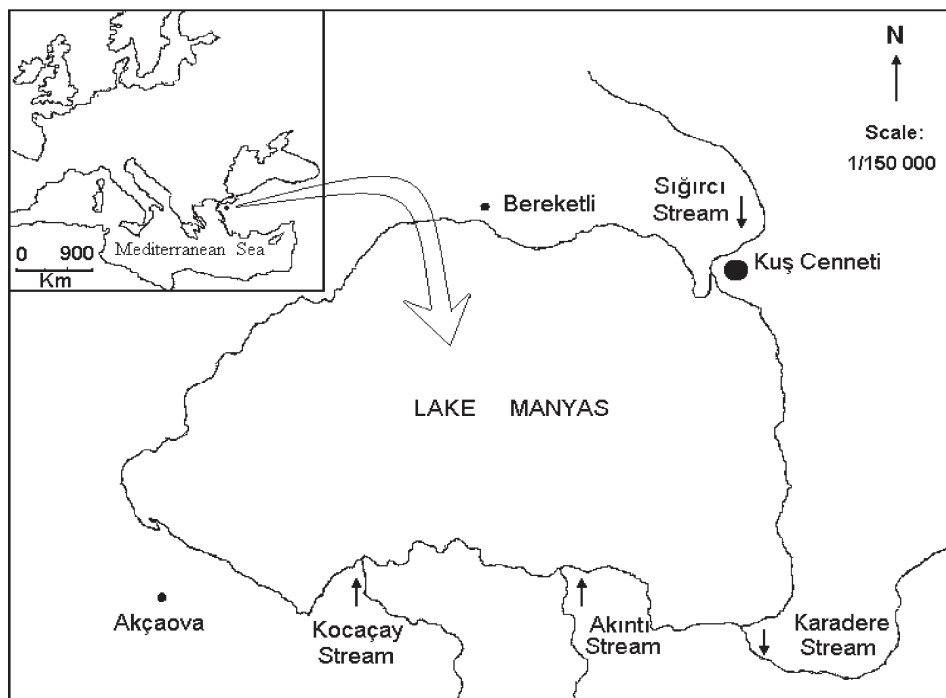


Fig. 1. Location of Lake Manyas in Northwest Turkey

Dactylogyrus species on the host fishes were studied by means of seasonal samples of 8 to 24 fishes from the each species in the Lake from January, 1997 to November, 1998. Fish specimens caught by local fishermen using gill-nets were placed in plastic containers containing lake water, and then, transferred to the research laboratory. After sacrificed, the lengths of the fishes were recorded and the gill-arches were cut off the body. The gills were examined and the parasites were isolated with the help of a stereo microscope with $\times 12$ and $\times 30$ magnification. Some of the parasites were fixed in glacial acetic acid and preserved using glycerin-gel under the cover glass in accordance with PRITCHARD and KRUSE (1982). For the identification of the parasite specimens, based on BYKHOWSKAYA-PAVLOVSKAYA *et al.* (1962), a light microscope with $\times 100$ and $\times 400$ magnification was used.

Data on parasite species were categorized according to the years (1997–1998) and seasons (spring, summer, autumn, and winter) as well as host fish sizes. To establish the connection with the seasonal changes, water temperature for each season was measured throughout the study period as shown in Figure 2. The research clearly shows that the temperatures are remarkably different for each season: spring (March–May), summer (June–August), autumn (September–November), and winter (December–February).

Total number of parasites was determined exactly by counting. 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

The study has findings which are summarized in Table 1. Their details related to the parasite species linked to the species of host fishes; prevalence and intensity levels on the basis of years, seasons, and host fish size.

The first finding of the study is related to the species of the parasites founded on the host fishes. In this connection, four *Dactylogyrus* species were found on gills of the host fishes: *Dactylogyrus sphyrna* LINSTOW, 1878 on *Blicca bjoerkna*; *Dactylogyrus crucifer* WAGENER, 1857 on *Rutilus rutilus*; *Dactylogyrus difformis* WAGENER, 1857 on *Scardinius erythrophthalmus*; *Dactylogyrus cornu* LINSTOW, 1878 on *Vimba vimba*.

Table 1. List of *Dactylogyrus* species found on four cyprinid fishes in Lake Manyas

Efn	Ifn & (%)	Ip – Hf	M & (X \pm S.D.)	Σ
123	51 (41.5)	<i>D. crucifer</i> – <i>R. rutilus</i>	2–25 (10.65 \pm 5.79)	544
148	21 (14.2)	<i>D. cornu</i> – <i>V. vimba</i>	6–50 (30.24 \pm 11.30)	635
135	38 (28.1)	<i>D. difformis</i> – <i>S. erythrophthalmus</i>	2–120 (31.71 \pm 30.95)	1205
115	33 (28.7)	<i>D. sphyrna</i> – <i>B. bjoerkna</i>	1–64 (16.76 \pm 16.88)	554

Efn: examined fish number, Ifn: infected fish number, Ip: identified parasite species, Hf: host fishes, M: minimum-maximum parasite number, X: mean intensity, S.D: standard deviation, Σ : total parasite number

Table 2. Intensity and prevalence of *Dactylogyrus* species of the host fishes in Lake Manyas

Parasite species	1997				1998			
	Efn	Prv	Mnx	Int	Efn	Prv	Mnx	Int
<i>D. crucifer</i>	59	35.5	3–18	9.4±4.5	64	46.8	12–20	11.4±6.4
<i>D. cornu</i>	79	0	0	0±0.0	69	30.4	6–50	30.2±11.3
<i>D. difformis</i>	73	35.6	2–48	17.6±14.6	62	19.3	12–120	62.1±35.5
<i>D. sphyrna</i>	55	21.8	4–16	8.1±3.2	60	35.0	1–64	21.7±19.4

Efn: examined fish number, Prv: prevalence (%), Mnx: Minimum-maximum parasite number, Int: mean intensity and standard deviation

The second finding of the study is related to the prevalence and intensity levels on the basis of the years in the study period (Table 2). Prevalence and mean intensity of the parasite species was higher in 1998 than in 1997, but there was no statistically significant difference among the three parasite species in this respect ($P > 0.05$), except *D. cornu* which had a meaningful prevalence ($P < 0.01$). It seems that the basic reason for this difference was the absence of *D. cornu* on the gills of *V. vimba* in 1997, whereas it was commonly found in 1998.

While, maximum intensity was recorded for *D. difformis*, it was the lowest for *D. crucifer*, but there were no significant differences among the parasite species ($P > 0.05$). In 1997, the maximum intensity was found for *D. difformis* with 48 specimens in summer on *S. erythrophthalmus*. In 1998, the intensities for all the parasite species were significantly higher than in 1997. The highest intensity level was again found for *D. difformis* with 120 specimens in summer on *S. erythrophthalmus*.

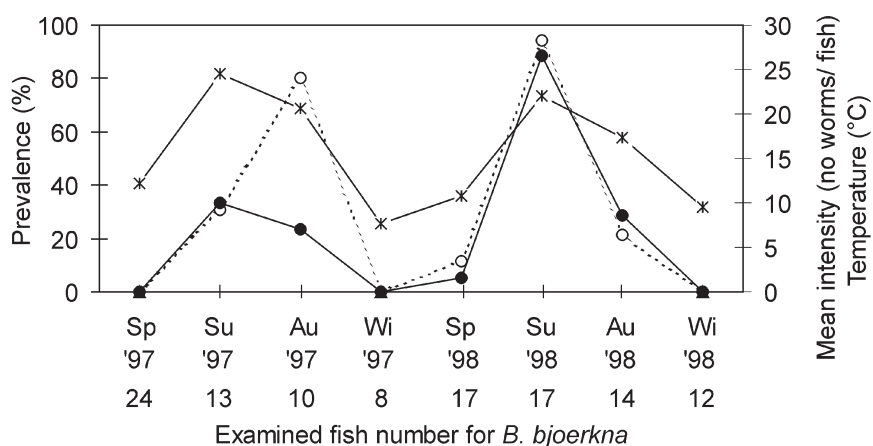


Fig. 2. Prevalence (broken line) and mean intensity (solid line) of *D. sphyrna* on *B. bjoerkna* in Lake Manyas over two years, and the water temperature (*) of the Lake during the study period (surface)

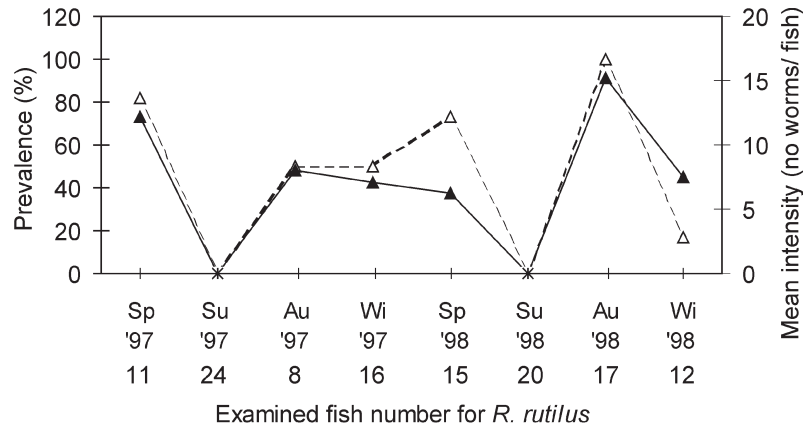


Fig. 3. Prevalence (broken line) and mean intensity (solid line) of *D. crucifer* on *R. rutilus* in Lake Manyas over two years

The third finding of the study is linked to seasonal changes in the prevalence and intensity levels of the parasite species (Figs 2–4). Figure 2 clearly shows that the changes in the water temperature in the study area were not constant, that is, it changes sharply during different seasons. As it is seen, the intensity of the species was highest in summers and autumns. It decreased between late autumn and winter for the entire three parasite species, except for *D. crucifer*.

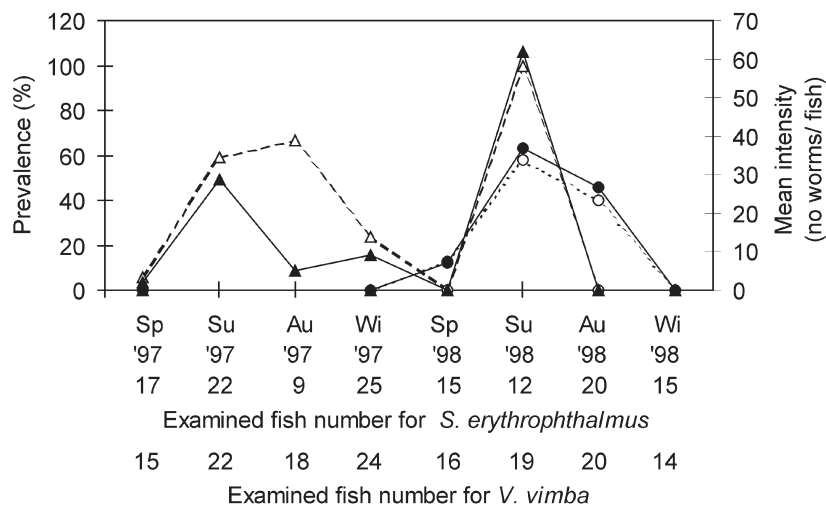


Fig. 4. Prevalence (broken line) (○: *D. cornu*, △: *D. difformis*) and mean intensity (solid line) of the parasite species (●: *D. cornu*, ▲: *D. difformis*) on *Vimba vimba* and *Scardinius erythrophthalmus* in Lake Manyas over two years

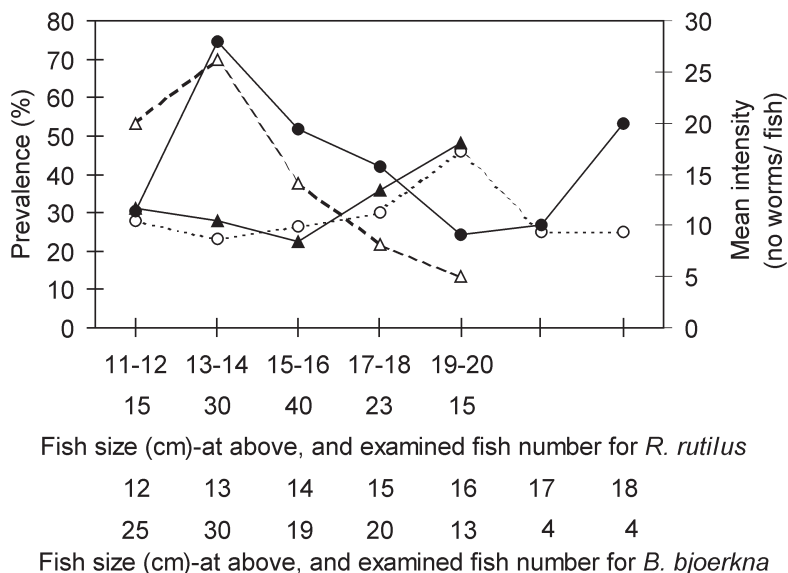


Fig. 5. Prevalence (broken line) (○: *D. sphyrna*, △: *D. crucifer*) and mean intensity (solid line) of the parasite species (●: *D. sphyrna*, ▲: *D. crucifer*) on *Blicca bjoerkna* and *Rutilus rutilus* in relation to the groups of fish size

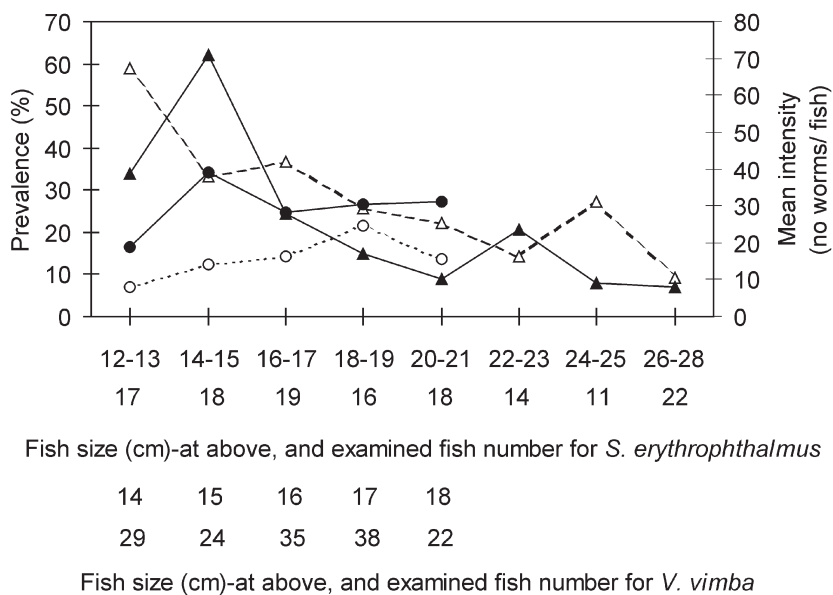


Fig. 6. Prevalence (broken line) (○: *D. cornu*, △: *D. difformis*) and mean intensity (solid line) of the parasite species (●: *D. cornu*, ▲: *D. difformis*) on *Vimba vimba* and *Scardinius erythrophthalmus* in relation to the groups of fish size

The final finding of the study is connected to prevalence and intensity levels of the parasite species on the basis of host fish sizes given in Figs 5 and 6. Both the prevalence and mean intensity levels of the parasite species varied in different host fish size. *D. difformis* was particularly founded on smaller host fish specimens and its prevalence was observed higher on such specimens than bigger ones (58.8%, 9.1%). While it had a maximum mean intensity of 70.8 ± 31.4 on the second group of the host fish size, it decreased on the bigger host fish sizes. *D. cornu* was founded on all sizes of the host fish with slightly changing prevalence rates between 21.5% and 6.9%. While its prevalence reached the maximum level on the middle host fish size, its mean intensity reached maximum level on the second group of the host fish size (39 parasites/fish). *D. sphyrna* was observed to be existed in all host fish sizes, except the last group, with a prevalence level changing erratically between from 46% and 23%. It reached the maximum mean intensity level on the second group of host fish size (28 parasites/fish). Similarly, *D. crucifer* existed in all host fish sizes. While its mean intensity reached its maximum level on the biggest host fish size (13.4 parasites/fish), its prevalence reached the maximum level in the second small host fish fish size (70.0%).

DISCUSSION

Several faunistic and seasonal studies on *Dactylogyrus* species have been done to date (VALTONEN *et al.* 1990, LUX 1990, POJMASŇKA 1994, LACASA-MILLÁN & GUTIÉRREZ-GALINDO 1995). Some of these studies are mainly focused on the existence of *Dactylogyrus* species in connection with host fish size and seasonal changes (KOSKIVAARA *et al.* 1991, ÖZTÜRK 2002). Such studies have shown that the *Dactylogyrus* species variety and richness changed from locality to locality. Similarly, this study determined the existence of four dactylogyrid species in Lake Manyas on the basis of seasonal dynamics and host fish size.

Temperature is commonly regarded as one of the most important factors determining the existence and abundance of monogenean parasites (KOSKIVAARA *et al.* 1991). While some of them tend to produce more at a higher water temperature, others prefer a cool water temperature (HANZELOVÁ & ŽITŇAN 1985). For example POJMAŇSKA (1995) found that the optimum period for the growth of *Dactylogyrus lamellatus* was in winter and the maximum infection level for *D. nobilis* was in autumn or spring when the water temperature was cool. This study also supports this view, observing that three dactylogyrid species, *D. cornu*, *D. difformis*, *D. sphyrna* were reached the maximum infection level in summer period when the water temperature was the highest and *D. crucifer* was reached the maximum infection level in spring and autumn with no infection level in summer.

However, it should be kept in mind that the seasonal abundance of dactylogyrids is sometimes more influenced by other abiotic and biotic factors than by temperature; e.g. *Dactylogyrus solidus* is very sensitive to oxygen depletion (BAUER 1962). Similarly, GONZALES-LANZA and ALVAREZ-PELLITERO (1982) claimed that the relationship of the *Dactylogyrus legionensis* to temperature was not clear, and that other abiotic (light, pH, oxygen and salinity) and biotic (spawning) factors had more influence on the existence of parasite species.

It is generally accepted that fish are exposed to increased monogenean infections during spawn period when they are most sensitive (HANZELOVÁ & ŽITŇAN 1985). CHUBB (1977) found that *Dactylogyrus* populations showed peaks in spring and early summer, the period during which many of their host fishes spawn. During this period, as well as during hibernation period in spring or summer, the resistance of fish decreases, causing an increase in reproduction of monogenetic species. This is another common finding that our study supports. In the study area, Lake Manyas, the spawning of the some cyprinid fish species takes place at the end of May and at the beginning of the June, when the water temperature is at least 21–24 °C (BALIK *et al.* 1997). This study found that the intensity of *Dactylogyrus* infection already started rising in spring when the water temperature just began to rise. Therefore, it can be concluded that the high dactylogyrid intensities in spring and early summer were apparently influenced by the spawning of the host fish rather than the little increase in the water temperature.

As regards the relationship between the level of monogenean infection and the size of the host fish, there have been several researches. As one of them, GONZALES-LANZA and ALVAREZ-PELLITERO (1982) found that the prevalence of a *Dactylogyrus* species on the host fish aged 2–7 years was higher than other ages. Similarly, KOSKIVAARA *et al.* (1991) did not find any monogenean parasites on roach under 3 years old. Therefore, they concluded that *Dactylogyrus* infection increased with the age of the roach due to the fact that the older fish have a larger gill surface area with no permanent immunity against these parasites. The present study is in parallel with this conclusion regarding three species, *D. cornu*, *D. crucifer*, *D. sphyrna* it determined. On the other hand, it found that, the other species, *D. difformis*, was more abundant in young host fishes than older ones in parallel with the results published in an earlier work by ÖZTÜRK (2002).

In conclusion, a new locality, Lake Manyas in Asia Minor (Turkey), is found for existence of the four *Dactylogyrus* species. In this connection, it contributes to the existing studies, focussing on the relationship between parasite species and host fish species in a different geographical location. In addition, it examines the occurrence, prevalence, and intensity levels of infection linked to seasonal changes and host fish sizes.

REFERENCES

- BALIK, S., USTAOĞLU, M. R. & SARI, H. M. (1997) *An investigation on growth and reproduction characters of rudd (S. erythrophthalmus) from Lake Kuş*. IX. Symposium of National Aquaculture. September 17–19, Eğirdir. [In Turkish]
- BAUER, O. N. (1962) *Parasites of freshwater fish and the biological basins for their control*. Israel Program Scientific Translations, Jerusalem, 236 pp.
- 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 Cat. No. 1136, Jerusalem, 919 pp.]
- CHUBB, J. C. (1977) Seasonal occurrence of helminths in freshwater fishes Part. I. Monogeneoidea. *Advances in Parasitol.* **15**: 133–139.
- ERK'AKAN, F. (1997) *Management Project of Lake Manyas*. Hacettepe Univ. Science Faculty Dept. of Biology, Project No: 94K100010. [In Turkish]
- GONZALEZ-LANZA, C. & ALVAREZ-PELLITERO, P. (1982) Description and population dynamics of *D. legionensis* n. sp. from *Barbus barbus bocagei* Steind. *J. Helminthol.* **56**: 263–273.
- HANZELOVÁ, V. & ŽITŇAN, R. (1985) Epizootiologic importance of the concurrent monogenean invasion in carp. *J. Helminthologia* **22**: 277–283.
- KOSKIVAARA, M., VALTONEN, E. T. & PROST, M. (1991) Dactylogyrids on the gills of roach in Central Finland: Features of infection and species composition. *Int. J. Parasitol.* **21**: 565–572.
- LACASA-MILLÁN, M. I. & GUTIÉRREZ-GALINDO, J. F. (1995) Study of the monogenea of cyprinidae in the Ilobregat River (NE Spain). I. Parasites of *Cyprinus carpio*. *Acta Parasitologica* **40**: 72–78.
- MARGOLIS, L., ESCH, G. W., HOLMES, J. C., KURIS, A. M. & SCHAD, G. A. (1982) The use of ecological terms in parasitology (Report of an ad hoc Committee of the American Society of Parasitologist). *J. Parasitol.* **68**: 131–133.
- LUX, E. (1990) Population dynamics and interrelationships of some Dactylogyrus and Gyrodactylus species on *Cyprinus carpio*. *Angew. Parasitol.* **31**: 143–149.
- ÖZTÜRK, M. O. & ALTUNEL, F. N. (2001) The occurrence of cestodes in four species (*Blicca bjoerkna*, *Rutilus rutilus*, *Scardinius erythrophthalmus*, *Vimba vimba*) of Cyprinidae from Manyas Lake. *Ankara Üniv. Vet. Fak. Derg.* **48**: 43–50. [In Turkish]
- ÖZTÜRK, M. O. & ALTUNEL, F. N. (2002) Observations on the parasite fauna of Danube bleak (*C. chalcoides*) from Lake Manyas, and a new record (*D. chalcaburni*) for helminth fauna of Turkey. *İstanbul Üniv. Vet. Fak. Derg.* **28**: 1–9. [In Turkish]
- ÖZTÜRK, M. O. (2002) Metazoan parasites of the tench (*Tinca tinca* L.) from Lake Uluabat. *Israel J. Zool.* **48**: 285–293.
- POJMAŃSKA, T. (1994) Infection of common carp, and three introduced herbivorous fish from Żabieniec fish farm, in relation to their sizes. *Acta Parasitol. Polonica* **39**: 16–24.
- POJMAŃSKA, T. (1995) Seasonal dynamics of occurrence and reproduction of some parasites in four cyprinid fish cultured in ponds. Monogenea. *Acta Parasitol. Polonica* **40**: 79–84.
- PRITCHARD, M. H. & KRUSE, G. O. W. (1982) *The Collection and Preservation of Animal Parasites*. Univ. of Nebraska Press, Lincoln.
- VALTONEN, E. T., PROST, M. & RAHKONEN, R. (1990) Seasonality of two gill monogeneans from two freshwater fish from an oligotrophic lake in northeast Finland. *Int. J. Parasitol.* **20**: 101–107.

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